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The Impacts of Biased Resource Allocation on the Effectiveness of Official Development Assistance

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Abstract

Many developing countries are receiving official development assistance (ODA). Whether ODA is beneficial or harmful to the receiving country is controversial in the literature. This paper analyzes this issue from a new angle by adopting the framework of competitiveness which allows us to link resource allocation with economic growth. Under this framework, we point out that the mechanism of resource allocation influences the effectiveness of ODA on economic growth. By applying data envelopment analysis (DEA) to competitiveness, we capture the effects of inefficient and biased allocation of resources on ODA. The data confirm the co-existence of positive and negative impacts of ODA. Finally, we conclude that current ODA are not efficient in helping most of the receiving countries.

Keywords: Official development assistance, data envelopment analysis, endowment effect, misallocation effect, biased effect

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1. Introduction

There are positive and negative impacts of foreign aids on the receiving country in the literature. Those who advocate positive effects[1] assume the additional resources can be allocated appropriately to enhance production capacity of the receiving country. Opponents of foreign aids[2] say that aids would distort the economy by importing inappropriate resources and/ or lowering government efficiency. This means the additional resources from aids are diverted to wrong places. Some researchers found that the final impacts of foreign aids depend on the quality of policies (Burnside and Dollar, 2000). Again, good policies allocate new resources from foreign aids efficiently whereas misallocation of resources is found in bad policies.

Those foreign aids, usually referred as the official development assistance (ODA), is defined as:

Flows of official financing administered with the promotion of the economic development and welfare of developing countries as the main objective, and which are concessional in character with a grant element of at least 25 percent (using a fixed 10 percent rate of discount). By convention, ODA flows comprise contributions of donor government agencies, at all levels, to developing countries and to multilateral institutions. (IMF, 2003)

In year 2015, over 150 billion USD ODA were sent to promote economic development and

[1] See Abidemi et al. (2011), Hatemi-J and Irandoust (2005), McGillivray and Morrissey (2000), Levy (1988), Gulati (1975), for various studies on the positive effects of ODA.

[2] See Hudson and Mosley (2008), Knack and Rahman (2007), Osei at al. (2005), Remmer (2004), Easterly (1999), Boone (1996), Feyzioglu (1998), Singh (1985), Griffin and Enos (1970), for different negative effects of ODA.

welfare of developing countries. They also accounted for a large proportion of the recipient's national income. Within over 120 ODA receiving countries, 27 of them have received ODA which is over 10% of their national income in 2015. In Tuvalu and Liberia, the ratio even came up to 89.2% and 62.4%. In view of the huge flow of resources in the form of ODA, it is important to ascertain the impacts of ODA. This paper improves upon the current literature by introducing a cohesive framework that models both positive and negative impacts of official development assistance (ODA). By concentrating on the aspect of resource utilization, we point out the positive effect (endowment effect) of ODA comes from the increase of resources. The negative effects of ODA come from two types of misallocation of resources: the inefficient mechanism of resource allocation of the receiving country (misallocation effect) and the adoption of developed countries' standard (biased effect). As a result, the recipients of ODA may be moving away from their optimal development path. These three effects can summarize all factors that influence the impacts of ODA. This helps us to focus on the overall effects of ODA. Of course, if one wants to study the impacts of particular factors, he can include individual factors.

To make the new model operational, we adopt the model of competitiveness developed by Porter (1990). This model views growth factors as a system that interact and reinforce each other. Thus, competitiveness includes not only economic factors but also non-economic factors such as education, sciences, political stability or value systems. A well-developed index of competitiveness contains the main features of the competitiveness model and allows us to assess the economic structure of a country through analyzing the tradeoff between growth factors and resources allocation.

New indicators of resource allocation are developed in this paper to capture the two negative effects of ODA. Specifically, by relating the economic structure of an economy and the dimensions of her competitiveness, we adopt Li and Zhao's (2015) data envelopment analysis (DEA) framework on studying competitiveness to determine the optimal structure. In turn, a misallocation of resources can be reflected by the degree of deviation from the optimal economic structure.

This paper is organized as follows: Section 2 discusses the positive and negative effects of ODA. Section 3 describes data envelopment analysis framework on competitiveness. Section 4 introduces the new bias variable. Section 5 discusses the initial results of applying DEA. Section 6 identifies the various impacts of ODA. Section 7 concludes.

2. Inefficient Allocation of Resources and Biased Value System

We believe that both positive and negative impacts of ODA appear. The positive impact mainly comes from the change of resource endowment (see for example, Creasey et al., 2015). A higher level of ODA injects more resources into a country. This stimulates economic growth directly. We call this the *endowment effect* of ODA.

For the negative impact, we think that it comes from inappropriate resource allocation of the receiving country. The additional resources from ODA are distributed to the economy through some organizations in the local economy. The impacts depend on the performance of government institutions, laws and regulations, local market structure, etc. When they are distributed efficiently, the endowment effect of ODA will show its maximum strength. However, it is well-known that in many developing

countries, markets are far from perfect and maximizing the social welfare may not be the only objective of government officials. Thus additional resources may not be allocated to their best uses. This diminishes the effectiveness of ODA on promoting economic growth. Further, there may be rent-seeking activities for different parties in the government and the commercial sectors to fight for the benefits of ODA (Moyo, 2009). This distracts some productive resources from the local economy. Studies found that aids influence the behavior of the government so that government intervention can crowd-out the positive effects of ODA (Oladi and Gilbert, 2015; Osei at al., 2005; Feyzioglu, 1998; Remmer, 2004; Hudson and Mosley, 2008; Singh, 1985). Moyo (2009) even argued that, by fostering corruptions and distorting the economy, aid had been the crucial factor holding Africa back. We call this the *misallocation effect* of ODA.

In addition to the inefficient resource allocation of ODA, it is well known that some developing countries follow the development strategy that, to various extents, embodies developed countries' value system. However, that may not be suitable to developing countries, or even harm their economic growth (Chang, 2005; Stiglitz, 2004; Lall, 2001; and Michael, 1997). For examples, some conditions are imposed along with ODA to promote Western social and economic rights in Africa (Tjønneland, 1998); ODA receiving countries are importing inappropriate resource and lowering government efficiency (Griffin and Enos, 1970; Boone, 1996; Easterly, 1999). The result is a negative impact on economic growth. We call the negative impacts caused by biased value system the *biased effect* of ODA. Let g be the economic growth rate of a country, X a vector of determinants of growth, R be an

indicator of resource allocation, and Δ be a measure of the bias generated from biased-value. A higher value of Δ means a larger bias. Thus we have the following:

$$g = f(ODA, \Delta, R, X). \quad (1)$$

From our previous discussions, the endowment effect of ODA on economic growth rate has direct positive impacts. Thus $\partial g/\partial ODA > 0$. When the additional resources of ODA are not allocated efficiently, the endowment effect will be weakened. Under the misallocation effect of ODA, a higher value of R indicates less efficient allocation of resources. Under the biased effect of ODA, a higher value of Δ means a value system closer to the developed countries' system. Both will lower the effectiveness of ODA. We expect there is interaction effect between misallocation effect, biased effect and ODA, so that $\partial\left(\frac{\partial g}{\partial ODA}\right)/\partial R < 0$ and $\partial(\frac{\partial g}{\partial ODA})/\partial\Delta < 0$.

3. Efficiency and Productivity Analysis to Competitiveness

This paper adopts competitiveness framework to measure the degrees of inefficient resource allocation and the biased-value. Unlike traditional growth model frameworks that treat different growth factors independent to each other, the competitiveness framework developed by Porter (1990) suggests that growth factors should be viewed as a system that interact and reinforce each other. One major different between traditional growth frameworks and competitiveness frameworks is that the competitiveness framework includes not only economic factors but also non-economic factors such as education, sciences, political stability or value systems. An important implication of such framework is that all growth factors, whatever economic or non-economic, can actually tradeoff between each

other. This framework allows us to assess the economic structure of a country though analyzing the tradeoff between different growth factors and thus the resource allocation.

To empirically apply the competitiveness framework, a weighted average competitiveness index that summarizes different growth factors of competitiveness measurement is used. Theory of stages of development (Porter, 1990) suggests that economies in different development stages should have different development needs.[3] Thus economies are divided into different groups which based on their development stages. Each group should have a unique set of weights that reflect the value system in that group. Following Li and Zhao (2015) and Despotis (2005), we treat each dimension of growth factors as an output. Let y_m be the mth dimension and w_m the corresponding weight of that dimension in the competitiveness index, $m = 1, \dots, M$. Denote the overall competitiveness index by C. Then

$$C = \sum_{m=1}^{M} w_m y_m$$

It is thought that there are tradeoffs among different dimensions but the ratio of tradeoff between any two dimensions is not constant. In particular, let $y = (y_1, y_2, \dots, y_M)$ be a vector of dimensions of the competitiveness index. The set of all feasible vectors of dimensions is $S = \{y: y \text{ is a vector that can be achieved by a county}\}$. Set S is called the feasible set of competitiveness.[4] Although all countries want to attain higher competitiveness, not all of them are on the frontier of the

[3] For example, a least developed country has less needs in innovation of new products than a developed country.

[4] It can be shown that such feasibility set of competitiveness can be derived from a simple production function with appropriate environmental factors. The authors are extending the result to more general cases.

feasible set. For example, in the following diagram, a country is observed to be at point y^0 with dimension vector (y_1^0, y_2^0). The straight line ww' reflects the weights of dimensions. The competitiveness index is at maximum at point $y^* = (y_1^*, y_2^*)$. Thus dimension weights indicate the "value" of each dimension and the competitiveness index is like the revenue of a firm (see Figure 1 for graphical illustration).

[Figure 1]

Previous empirical studies of competitiveness implicitly assume constant tradeoffs among dimensions. Thus every point on ww' is feasible. We believe that the rate of tradeoff is not constant. Such nonlinear nature is reflected by the curve ZZ'. To maximize competitiveness, the country needs to move from y^0 to y^*.

Two components are identified from y^0 to y^*. First, we think that the economic structure of a country can be reflected by the dimension mix of the competitiveness index. The country can choose to keep her observed structure and try to raise her competitiveness. Thus the first component is moving to the frontier from y^0 to y' through proportional expansion of all dimensions. Further improvement from y' to y^* requires a change of economic structure. The second component is moving from y' to y^* by changing the mix of dimension.

We measure the above three terms by adopting the framework and terminologies of Li and Zhao's (2015). Let the observed competitiveness index at y^0 be C^0. Then

$$C^0 = \sum_{m=1}^{M} w_m {y_m}^0. \quad (2)$$

The highest level of competitiveness is

$$C^* = \max_{y}\{\sum_{m=1}^{M} w_m y_m : y \in S\} \quad (3)$$

The potential of improving competitiveness is indicated by the following measure of overall efficiency of competitiveness.

$$O_C^0 = C^*/C^0 \quad (4)$$

This is called the *efficiency of overall competitiveness*. The value $(O_C^0 - 1) * 100\%$ is the percentage of the competitiveness index of y^0 that can be increased. In the above diagram, $O_C = 0y^{"}/0y^0$. The component of proportional expansion of all dimensions is measured by

$$E_p = \max_{\theta}\{\theta : \theta y^0 \in S\}. \quad (5)$$

This is called the *efficiency of proportional competitiveness*. In the above diagram, $E_p = 0y'/0y^0$.

Let $C^p = \sum_{m=1}^{M} w_m\left(E_p y_m^p\right)$ to denote maximum competitiveness attainable when the dimension mix is kept constant. The component of improving competitiveness through changing the dimension mix is measured by the *efficiency of dimension mix*:

$$E_d = \frac{C^*}{C^p} = \left(\frac{C^*}{C^0}\right) / \left(\frac{C^p}{C^0}\right) = \frac{O_C}{E_p} \quad (6)$$

Thus $O_C = E_d E_p$. In the above diagram, $E_d = 0y^{"}/0y'$. It is easy to see that all O_C, E_p, and E_d are greater than or equal to one.

Empirically, the above problem can be solved by an output-orientated data envelopment analysis model. Suppose there are K observed countries. Let y_{mk} be the mth dimension of the

competitiveness index for country k, where $m = 1, \dots, M$ and $k = 1, \dots, K$. Using the variable returns to scale (VRS) frontier in (5), the efficiency of proportional competitiveness for country k, $k = 1, \dots, K$, is

$$E_p^k = \max_{\theta, z} \theta \tag{7}$$

subject to

$$\sum_{k=1}^{K} z_k y_{mk} \geqq \theta y_{mj} \quad m = 1, \cdots, M$$

$$\sum_{k=1}^{K} z_k = 1$$

$$z_k \geqq 0, k = 1, \dots, K.^5$$

Similarly, given weight vector w and the VRS frontier in (3), the corresponding maximum value of the competitiveness index is

$$C^* = \max_{y, z} \sum_{m=1}^{M} w_m y_m \tag{8}$$

subject to

$$\sum_{k=1}^{K} z_k y_{mk} \geqq \theta y_{mj}, m = 1, \cdots, M$$

$$\sum_{k=1}^{K} z_k = 1$$

$$z_k \geqq 0, k = 1, \dots, K$$

where the solution y^* is the optimal pillar vector for the weight vector w. Then O_C and E_p can be found

[5] The scores of the dimensions are normalized to 1 to 7 scales so that information along the lines of the inputs in the production process is not needed. An output-oriented DEA model without input is equivalent to an output-oriented DEA model with a single constant input (Kao et al. 2008; Lovell and Pastor 1999).

by combining (2), (4), (6) and (7), accordingly.

4. The Measurement of Inefficient Resource Allocation and Biased-value System

A well-constructed competitiveness index can reflect different aspects of an economy. For example, the global competitiveness index (GCI) developed by World Economic Forum covers the micro and macro environments, financial market, and institutions.[6] We think that the economic structure of a country can be reflected by the dimension mix of the competitiveness index. Compare to single weight in previous models (see, for example, Li and Zhao, 2015), the weight of each dimension indicates the significance of that dimension to the economy. Thus the optimal point is a dynamic point that maximizes the value of the competitiveness index determines the optimal economic structure of the economy in different development stages.

Suppose there are two groups, i (developing) and j (developed), of countries. The countries in the same group share the same values of their economic structures reflected by the weights of the competitiveness index. It is the country's interest to maximize the value of the competitiveness with respect to the weights of that group. Consider a country in group i with observed dimension vector y^i and the corresponding weights w^i. After maximum proportional expansion, the corresponding dimension vector is y^p. Thus the efficiency of proportional competitiveness for this country is $E_p^i =$

[6] There are twelve components of the global competitiveness index: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation.

$w^i \cdot y^p / w^i \cdot y^i$. Let the optimal dimension vector with respect to w^i be y^*. The value of the competitiveness index, $w^i \cdot y^*$, is at a maximum. The efficiency of dimension mix with respect to w^i is

$$E_d^{ii} = w^i \cdot y^* / w^i \cdot y^p.$$

If the observed dimension mix is different from the optimal mix, that means the observed economic structure is not optimal. Each economic structure implies a certain allocation of resources. By measuring the potential of improving competitiveness by changing the economic structure (i.e., changing dimensions), the efficiency of dimension mix of country i with respect to w^i ($E_d^{ii} = E_d$) reflects the degree of inefficient allocation of resources in the economy. If the inefficient allocation of resources in the whole economy reflects the degree of misallocation of the additional resources from ODA, then the efficiency of dimension mix can be used as an index of the misallocation, i.e., we substitute $R = E_d^{ii}$ in Equation (1).

On the other hand, when a country in group i, for example, adopts an economic structure that maximizes the value of the competitiveness index using the weights of country j, the dimension mix will deviate from the optimal mix. This creates a bias. Suppose the weights faced by another country in group j is w^j. If the efficiency of dimension mix is measured using w^j instead of w^i, then the corresponding efficiency of dimension mix of country i with respect to w^j is

$$E_d^{ij} = w^j \cdot y^{**} / w^j \cdot y^p$$

where y^{**} is the optimal dimension vector at the weight vector w^j. We expect the policy maker of each

country should aim at finding an economic structure that maximizes the value of the competitiveness index. Thus y^p should be far from y^{**}. The measure E_d^{ij} captures the deviation from the "wrong" optimal point. A higher value of E_d^{ij} means smaller bias. If the allocation of resources from ODA follows "wrong" weights, then this deviation from the optimal point is closely related to the inefficient allocation of the ODA resources. Hence E_d^{ij} can serve as an index of the biased effect. Let $\Delta = 1/E_d^{ij}$ in Equation (1). When a country in group i adopts a value system closer to that of group, y^p is closer to y^{**} and hence a smaller value of E_d^{ij}. This indicates a value system closer to "wrong" optimal and larger bias. This lead to a larger value of Δ.

5. Data Specifications and Initial Estimation

Data come from World Economic Forum and World Bank (Table A1). We adopt the Global Competitiveness Index (GCI) constructed by the World Economic Forum in our study. Discarding the countries without sufficient information, there are 121 countries in this study.

All dimensions of the competitiveness index are classified into three categories: (i) basic requirements; (ii) efficiency enhancers; and (iii) innovation and sophistication factors. According to development stage, countries are classified into three major groups: factor-driven economies (Stage 1), efficiency-driven economies (Stage 2), and innovation-driven economies (Stage 3). The Global Competitiveness Report also includes two additional transitional groups from Stage 1 to Stage 2 and from Stage 2 to Stage 3. The countries in each stage have different weights from the countries in other stages. In general, the four dimensions of basic requirements are keys for factor-driven economies.

Similarly, the six dimensions of efficiency enhancers are keys for efficiency-driven economies. The last two dimensions of innovation and sophistication factors are keys for innovation-driven economies.[7] In this study, the classification is simplified into three groups by combining transitional countries to their higher stage. Thus, the factor-driven group G1 includes exactly the economies of Stage 1. The efficiency-driven group G2 includes economies of Stage 2 and transitional economies from Stage 1 to Stage 2. The innovation-driven group G3 includes economies of Stage 3 and transitional economies from Stage 2 to Stage 3. The members of Group G3 are developed countries.

Using GCI and its dimensions of all countries, we can compute the efficiency of overall competitiveness (O_C) and its components (efficiency of proportional competitiveness (E_p), and efficiency of dimension mix (E_d)) as described in Section 3. Table 1 shows the geometric means of these three efficiency scores of competitiveness of all individual countries and in each group. The efficiency of overall competitiveness (O_C) shows a decreasing trend from Group G1 (1.702) to Group G2 (1.465), then Group G3 (1.217), which means developed countries are closer to the highest level of competitiveness. Its components, the efficiency of proportional competitiveness (E_p) and the efficiency of dimension mix (E_d), follows the same pattern that developed countries are more efficient. This is consistent with normal expectations. Note that all groups have a E_d value higher than E_p value, which means the potential improvement in efficiency of dimension mix is more than that of the efficiency of proportional competitiveness. This finding suggests that the policy maker should pay

[7] For details of the classification, see Schwab (2014 , pp. 4 – 11)

more attention to the economic structure for improving competitiveness. Thus we have our first result:

Result 1*: For all countries, changing economic structure is more effective to increase competitiveness than catching-up the competitiveness frontier.*

[Table 1]

Recall that each country belongs to a category in GCI and we use the weights of that category to compute O_C and E_p for that country in Table 1. In Table 2, the values of E_d is repeated from Table 1. It shows the geometric mean of efficiency of dimension mix of each economy with respect to the weights of its category. This reflects the misallocation effect. To see whether there are biases, we compute the efficiency of dimension mix of each country with respect to the weights of innovation-driven economies (Stage 3). The geometric mean of each group is listed in the column E_d^{i3} in Table 2. Note that a value of larger than 1 in E_d or E_d^{i3} means inefficiency and a score closer to one means higher efficiency with respect to the chosen weights. When a developing country aims at achieving higher competitiveness with respect to the weights in its own group, it should be far from the optimal mix of G3. Thus we expect that $E_d \leqq E_d^{i3}$. This is the case for all groups in Table 2 except the group of factor-driven countries (G1). So we conclude that:

Result 2: *Factor-driven countries are biased towards innovation-driven economies.*

[Table 2]

Group G1 seems more dimension mix efficient if they are treated, incorrectly, as innovation-driven economies. In other words, this group has a value of E_d^{i3} greater than E_d and the development

pattern of G1 seems biased towards developed countries. This result reveals that factor-driven economies may have allocation bias towards innovation-driven economies.

We also compute the variable ODA as the average ratio of net official development assistance and official aid received to GDP of each country over the four years 2010-2013. The average ODA of each category is listed in the last column of Table 2. It is found that average ODA of Group G1 is much higher than those of all other groups. Together with the fact that Group G1 is the only group that has a value of $E_d > E_d^{i3}$, we may suspect if the biased effect of ODA has a larger influence on the effectiveness of ODA on economic growth for factor-driven countries.

6. Impacts of ODA on Economic Growth

To investigate the impacts of ODA on economic growth, we estimate the empirical models of Equation (1). The economic growth rate (g) is the growth rate of GDP per capita (constant 2005 US$) of each economy during 2011 to 2014. The variable ODA is the average ratio of net official development assistance and official aid received to GDP as defined in the previous section. The variable of misallocation effect is $R = E_d$ as discussed in Section 4. Similarly, the variable of biased effect is $\Delta = 1/E_d^{i3}$. There are twelve competitiveness dimensions (called "pillars" by World Economic Forum) in the GCI index. These dimensions include the set of institutions, policies, and factors that determine the level of productivity of a country. Thus the competitiveness index of a country has already summarized all important factors to economic growth of that country. Thus the vector X in Equation (1) is represented by the Global Competitiveness Index (GCI) in Schwab (2011-2014).[8]

[8] The authors are working on the relation between competitiveness and economic growth. In the preliminary result, a strong causality from GCI to economic growth rate has been found.

Following the common practice in development economics, we add the natural logarithm of the GDP per capita (constant 2005 US$) in year 2010 as a control variable to the empirical model of Equation (1). This variable is denoted by $ln(Y_{2010})$ for the catching up effect. The descriptive statistics of the variables for the selected 121 countries are listed in Table 3 and the correlation matrix of the variables are shown in Table 4:

[Table 3]

[Table 4]

The first empirical model of Equation (1) is

$$g = a_1 + a_2 ln(Y_{2010}) + a_3 ln(GCI) + a_4 ODA + a_5 R + a_6 \Delta + a_7 ODA \cdot R \cdot D_1 + a_8 ODA \cdot R \cdot D_2 + a_9 ODA \cdot \Delta \cdot D_1 + a_{10} ODA \cdot \Delta \cdot D_2 + e. \quad \text{(Model A)}$$

The endowment effect of ODA is reflected by a_4. Since we believe ODA can raise economic growth rate through this effect, we expect that $a_4 > 0$. The misallocation effect and the biased effect of ODA are indicated by the coefficients of R and Δ respectively. They are expected to be negative. Thus $a_5 < 0$ and $a_6 < 0$. Model A allows the effects of ODA to be conditioned on the misallocation effect (R) and the biased effect (Δ), and allows these effects to be different for factor-driven economies (Group G1) and efficiency-driven economies (Group G2). These effects are captured by the interaction terms, where $D_i = 1$ for countries in Group Gi and 0 otherwise, $i = 1, 2$. If the relation between economic growth rate and ODA is influenced by R and Δ, then $a_i < 0, i = 7, 8, 9, 10$. In general, we expect that such influences are stronger in factor-driven economies. This means $|a_7| > |a_8|$ and $|a_9| > |a_{10}|$.

Table 5 lists the regression results. For comparison, Model A' without the misallocation and

biased effects is estimated. The control variables of Model A' are highly significant with expected signs. ODA is insignificant. In Model A, all estimated coefficients of terms including ODA, except one, are individually insignificant. However, they are jointly significant at 5% level. Thus ODA should be included in the regression model. The standard errors of $ln(Y_{2010})$, $ln(GCI)$ and ODA are larger in Model A than those in Model A' in spite of higher adjusted R-squared. This is an indication of multicollinearity.

[Table 5]

From Table 4, only three pairwise correlation coefficients out of fifteen are larger than 0.8. This indicates the possibilities of multicollinearity in the regression model. In particular, GCI is highly correlated with more variables than other regressors. To release the impacts of multicollinearity, we modify the model by replacing $ln(Y_{2010})$ and $ln(GCI)$ with $ln(GCI/Y_{2010})$ as follows: [9]

$$g = b_1 + b_2 ln(GCI/Y_{2010}) + b_3 ODA + b_4 R + b_5 \Delta + b_6 ODA \cdot R \cdot D_1 + b_7 ODA \cdot R \cdot D_2 + b_8 ODA \cdot \Delta \cdot D_1 + b_9 ODA \cdot \Delta \cdot D_2 + e. \quad \text{(Model B)}$$

The results are Model B in Table 5. With slightly smaller value of adjusted R-squared (from 0.3491 to 0.3489), all standard errors are smaller. Thus the estimates in Model B are more precise than those in Model A with a cost of marginally lower goodness-of-fit. So Model B is used for further analysis. Two key hypotheses are tested in Model B:

[9] The restriction $a_2 + a_3 = 0$ cannot be rejected in Model A.

Hypothesis B1: $b_4 = b_5 = 0$

Conclusion: B1 can be rejected with a p-value of 0.000. There are direct impacts in at least one of misallocation and biased effects.

Hypothesis B2: $b_6 = b_7 = b_8 = b_9 = 0$

Conclusion: B2 can be rejected with a p-value of 0.035. The impacts of ODA are affected by at least one of misallocation and biased effects for countries in Group G1 and Group G2.

Guided by the tests of these two hypotheses and investigating the estimated coefficients in Model B, we obtain the final empirical model:[10]

$$g = c_1 + c_2 \ln(GCI/Y_{2010}) + c_3 ODA + c_4 R + b_5 ODA \cdot \Delta \cdot D_1 + b_6 ODA \cdot \Delta \cdot D_2 + e \quad \text{(Model C)}$$

All coefficients in Model C are significant (Table 5). The adjusted R-squared increases from 0.349 to 0.354. All standard errors are smaller. Thus there are improvements in goodness-of-fit and precision of estimated. In particular, the negative sign of the coefficient of E_d suggests 1 percentage point increase in inefficient allocation of resources will result in 0.014% decrease in economic growth rate.

Result 3*: Inefficient allocation of resources adversely affects the economic growth directly.*

Moreover, our model reveals that the direct impact of ODA on economic growth is positive ($c_3 = 0.718 > 0$). If ODA increases by 1 percentage point, economic growth will be increased by

[10] In the joint test of the null hypothesis: $b_5 = b_6 = b7 = 0$ in Model B, the p-value is 0.67. The null hypothesis cannot be rejected at any meaningful level of significance.

0.718 percentage point.

Result 4*: The direct impact of ODA is positive.*

Our study contributes to the literature by introducing a new variable, Δ, which measures the effects of allocation of resources towards a biased value system. We show that such bias adversely affects the impacts of ODA on economic growth. Note that $\Delta = 1/E_d^{i3}$ and $0 < \Delta < 1$, where $\Delta = 1$ means completely biased value system towards innovation-driven economies. In particular, for Group G1 countries ($D_1 = 1$) the effect of ODA on economic growth, conditioned on bias is absolutely larger comparing with that for Group G2 countries ($D_2 = 1$). Both coefficients are negative ($b_5 < b_6 < 0$). That reveals the biased effect is more serious in Group G1 countries.

Result 5*: Inefficient allocation of resources towards a biased value system adversely affects the impacts of ODA on economic growth, especially in the least developed countries.*

We further calculate the net impact of ODA. The net impact of ODA is reflected by $(0.718 - 1.132\Delta)$ for Group G1 countries ($D_1 = 1$) and $(0.718 - 0.921\Delta)$ for Group G2 countries ($D_2 = 1$). We note that the minimum and maximum values of Δ in the sample for $D_1 = 1$ are 0.680 and 0.840, while the minimum and maximum values of Δ in the sample for $D_2 = 1$ are 0.648 and 0.854. Computation of lower and upper bounds of the data are as follows:

[Table 6]

Thus we reveal that the net impact of ODA can be positive, zero and negative, but in Group G1 countries, the net impact is always negative.

Result 6*: The net impact of ODA can be positive, zero and negative, but always negative in the least developed countries.*

Finally, we calculate the net impact of ODA in our sample. There are 80 ODA receiving countries out of a sample size of 121, which 31 of them belongs to Group G1, 35 of them belongs to Group G2, and 14 of them belongs to Group G3. Based on our analysis, only 29 of them have positive net effect.[11] None of these 29 economies are in Group G1. Countries in Group G1 are usually the main target of ODA but our results show that these countries cannot benefit from ODA. Developed countries and global institutions should rethink their policy of granting ODA. We present our last result as follows:

Result 7*: Current ODA is ineffective to raise the economic growth of the receiving countries, especially in the least developed and less developed countries.*

7. Conclusion

In this paper, we analyze the impacts of ODA from a new angle by pointing out that the mechanism of resource allocation influences the effectiveness of ODA on economic growth. Three new concepts of resource allocation of ODA are introduced. By adopting the frameworks of competitiveness and data envelopment analysis, we can assess the economic structure of a country and find proxies of the two types of inefficient allocation of resources. One caveat is that the proxies of the

[11] 15 in Group G2, and 14 in Group G3. Refer to Table A2 in appendix for detail.

two inefficient allocation of resources actually reflect the inefficiency of the whole economy, not just that of ODA resources.

This paper synthesizes both views of ODA in one cohesive framework, which allows us to identify both positive and negative impacts of ODA in one model. We found supports that the net impact of ODA depends on the value of bias caused by inefficient allocation of resources and the adoption of biased value system. Hence the co-existence of both positive and negative effects of ODA is possible in real world data. Thus both positive and negative views of ODA in the literature are correct in some sense.

In principle, ODA does work in the sense of helping needed countries if they can allocate such additional resources efficiently. The cruel truth is that most receivers of ODA are unable to transform such resources to productive uses. Even worse is that ODA actually lowers the economic growth of receiving countries. Hence the donating countries or global institutions may have to review their existing policy of granting aids.

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Appendix

Table A1: Data specification and Source

Data	Source
Growth rate of GDP per capita (constant 2005 US$)	World Development Indicators, World Bank
GDP per capita (constant 2005 US$)	World Development Indicators, World Bank
GDP (constant 2005 US$),	World Development Indicators, World Bank
Net official development assistance and official aid received (constant 2012 US$)	World Development Indicators, World Bank
Global competitiveness index	The Global Competitiveness Report, World Economic Forum (Various years)

Table A2: List of the Countries in the Study

Stage 1	Stage 1 to 2	Stage 2	Stage 2 to 3	Stage 3
Bangladesh*	Algeria*	Albania*	Argentina^	Australia
Burkina Faso*	Azerbaijan*	Armenia^	Bahrain	Austria
Burundi*	Bolivia*	Bulgaria	Barbados^	Belgium
Cambodia*	Botswana^	Cape Verde*	Brazil^	Canada
Cameroon*	Honduras^	China^	Chile^	Cyprus
Chad*	Iran, Islamic Rep.*	Colombia^	Costa Rica^	Czech Republic
Cote d'Ivoire*	Moldova*	Dominican Republic^	Croatia^	Denmark
Ethiopia*	Mongolia*	Egypt*	Hungary	Estonia
Gambia, The*	Philippines^	El Salvador^	Kazakhstan^	Finland
Ghana*	Saudi Arabia	Georgia*	Latvia	France
Haiti*	Venezuela*	Guatemala^	Lebanon^	Germany
India*		Guyana^	Lithuania	Greece
Kenya*		Indonesia^	Malaysia^	Hong Kong SAR
Kyrgyz Republic*		Jordan^	Mauritius^	Iceland
Lesotho*		Macedonia, FYR^	Mexico^	Ireland
Madagascar*		Montenegro^	Panama^	Israel
Malawi*		Morocco^	Poland	Italy
Mali*		Namibia^	Russian Federation	Japan
Mauritania*		Paraguay*	Turkey^	Korea, Rep.
Mozambique*		Peru^	United Arab Emirates	Netherlands
Nepal*		Romania	Uruguay^	Norway
Nicaragua*		Serbia*		Portugal
Nigeria*		South Africa^		Qatar
Pakistan*		Sri Lanka^		Singapore
Rwanda*		Swaziland^		Slovak Republic
Senegal*		Thailand		Slovenia
Tanzania*		Timor-Leste*		Spain
Uganda*		Ukraine*		Sweden
Vietnam*				United Kingdom
Zambia*				United States
Zimbabwe*				

Note: Grouping follows Schwab (2014, pp. 4 – 11); "*" denotes ODA receiving countries with negative net effect; "^" denotes ODA receiving countries with positive net effect.

Figure 1 Competitiveness ‘frontier’

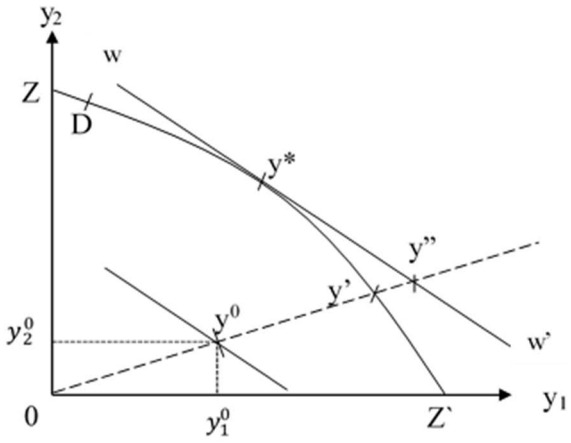

Table 1: The Efficiency of Competitiveness and its Decomposition[12]

Country Group	Obs	O_C	E_p	E_d
All	121	1.408	1.156	1.218
G1	31	1.702	1.298	1.311
G2	39	1.465	1.181	1.241
G3	51	1.217	1.060	1.149

All: All Economies in GCI

G1: Factor-driven economies

G2: Efficiency-driven economies (including transitional economies from Stage 1 to Stage 2)

G3: Innovation-driven economies (including transitional economies from Stage 2 to Stage 3)

O_C: overall competitiveness, geometric average (2011 – 2014)

E_p: efficiency of proportional competitiveness, geometric average (2011 – 2014)

E_d: efficiency of dimension mix using individual weights, geometric average (2011 – 2014)

[12] Some countries are excluded due to availability of data. For detail list of the countries, see Table A2.

Table 2: Misallocation of resources using own weights and "wrong" weights

Country Group	Obs	E_d	E_d^{i3}	ODA
All	121	1.218	1.228	3.71
G1	31	1.311	1.299	10.37
G2	39	1.241	1.272	3.16
G3	51	1.149	1.156	0.08

All, G1, G2, G3 and E_d: See the definitions in Table 1.

E_d^{i3}: efficiency of dimension mix using weights of Stage 3, geometric average (2011 – 2014)

ODA: ratio of net official development assistance and official aid received to real GDP (2010-2013)(%)

Table 3: Descriptive Statistics of the Regression Variables

	g	Y_{2010}	GCI	E_d	Δ	ODA
Mean	0.022	11369	4.215	1.222	0.817	0.037
Median	0.021	4107	4.189	1.222	0.810	0.003
Maximum	0.103	66117	5.639	1.492	0.988	0.328
Minimum	-0.042	147	2.905	1.012	0.648	0.000
Std. Dev.	0.023	15357	0.648	0.101	0.070	0.065

Table 4: Correlation Matrix of the Variables

	g	Y_{2010}	GCI	E_d	Δ	ODA
g	1					
Y_{2010}	-0.390***	1				
GCI	-0.173*	**0.797*** **	1			
E_d	0.051	-0.677***	**-0.878*** **	1		
Δ	-0.117	0.729***	**0.861*** **	**-0.945*** **	1	
ODA	0.177*	-0.394***	-0.607***	0.548***	-0.511***	1

Note: "***", "**" and "*" indicate significance at 1%, 5% and 10% levels respectively.

Table 5: Estimation Results of Regression Model

	Model A	*Model A'*	*Model B*	*Model C*
$ln(Y_{2010})$	-0.017*** (0.003)	-0.015*** (0.002)		
$ln(GCI)$	0.048 (0.031)	0.097*** (0.023)		
$ln(GCI/Y_{2010})$			0.016*** (0.002)	0.017*** (0.002)
ODA	0.964 (0.816)	-0.040 (0.038)	0.987 (0.816)	0.718** (0.344)
R	-0.165*** (0.062)		-0.189*** (0.058)	-0.138*** (0.026)
Δ	-0.094 (0.083)		-0.085 (0.082)	
$D_1 \cdot R \cdot ODA$	-0.235 (0.366)		-0.224 (0.366)	
$D_2 \cdot R \cdot ODA$	-0.039 (0.439)		-0.002 (0.437)	
$D_1 \cdot \Delta \cdot ODA$	-1.006 (0.619)		-1.070* (0.6160)	-1.132** (0.483)
$D_2 \cdot \Delta \cdot ODA$	-1.190* (0.714)		-1.303* (0.706)	-0.921* (0.495)
Constant	0.377** (0.147)	0.011 (0.023)	0.437*** (0.135)	0.310*** (0.044)
Adj R-squared	0.349	0.272	0.349	0.354
n	121	121	121	121

Note: "***", "**" and "*" indicate significance at 1%, 5% and 10% levels respectively. Numbers in brackets represent standard error of the coefficient.

Table 6: Lower and Upper Bounds of the Net Impacts of ODA

For stage 1 countries,	Impact of ODA at the minimum bias in the sample $= 0.718 - 1.132(0.680)$ $= -0.052 < 0$
	Impact of ODA at the maximum bias in the sample $= 0.718 - 1.132(0.840)$ $= -0.233 < 0$
For stage 2 countries,	Impact of ODA at the minimum bias in the sample $= 0.718 - 0.921(0.648)$ $= 0.121 > 0$
	Impact of ODA at the maximum bias in the sample $= 0.718 - 0.921(0.854)$ $= -0.069 < 0$