EFFECTS OF DEVELOPMENT AID ON TRADE FLOWS

A UNITED STATES PERSPECTIVE

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Abstract

International agreements stipulate that developed nations should spend 0.7% of their GDP on development aid, yet many countries do not reach this goal. This has various reasons, however some say that government funds should be used at home, rather than abroad. This reasoning neglects the possible effects of donating development aid on trade flows between donating and recipient countries. Previous research indicates that an increase in donated aid leads to larger trade flows, however there are often doubts about the reliability of these results, among others due to possible endogeneity issues. This study adds to the existing literature by applying a difference-in-difference method in an attempt to deal with possible endogeneity issues. Looking at the United States as donating country in the years 1999-2008, the introduction of the PEPFAR aid program, which aims to combat HIV/AIDS, is used as a treatment, since recipients are chosen for exogenous reasons. Treated countries are matched to similar countries that did not receive treatment by being part of the PEPFAR program, which are then used as a control group. This study finds that there was a 42% stronger increase in US exports to the recipient country in the PEPFAR program during the treatment period than to countries in the control group at a 5% significance level. This strengthens earlier findings in existing literature that an increase in aid leads to higher exports from the donor country to the recipient country. No statistically significant effect for donated aid is found with regard to US imports from the recipient country.

Contents

1. Introduction

Internationally, countries have set a goal to spend 0.7 percent of their GNI on development aid. Despite this agreement, in 2019 only 5 out of 24 members of the Development Assistance Committee (DAC) from the Organization for Economic Co-Operation and Development (OECD) met this goal. DAC members include developed European countries as well as countries like Canada, the United States, Japan and Australia. 2019 was not an exception, because consistently only a small number of DAC members meet their goal. According to the information from OECD reports, DAC members collectively only spent 0.3 percent of the GNI on what the OECD calls Official Development Assistance (ODA). This suggests development aid is not a priority for most governments in developed countries. This could have many explanations. Perhaps government officials think it would not earn them any votes, assuming development aid only benefits people in recipient countries. Most recently, the UK government was criticized by the opposition after it cut spending on foreign aid, claiming it was necessary to restore the public finances after the pandemic. However, previous research has found that development aid also benefits the donor country.

This existing research uses the Gravity Model, created by Jan Tinbergen, to estimate the effect of donated aid on trade flows between the donating country and the recipient country. Generally, an increase in aid is believed to lead to an increase in donor country exports to the recipient and an increase in donated aid is believed to have an insignificant effect on donor country imports from the recipient country. However, there is no consensus on the accuracy of these estimations, since various estimation methods have been used and there are possible endogeneity issues. In addition, no study has focussed on the United States yet with regard to total development aid donated by the US. Therefore, it is possible to add to the existing literature by using a new method while focussing on a new donor country, in an attempt to reinforce the existing literature. This leads to the following research question:

What are the effects of development aid donated by the United States on trade volumes between the United States and recipient countries?

This question is relevant from several perspectives. First of all, the question is relevant from an academic perspective. The topic of the effects of aid on trade has received some attention from academics in the two decades, however questions still remain because there is not a single conclusive method yet to research this topic. This study will add another method to the existing literature, and thus it will either reinforce or question existing ideas on the topic.

Second of all, it is relevant for policymakers, as the outcome of this research may influence decisions on how much to spend on foreign aid. Of course, even if foreign aid does not stimulate trade,

one might still want to spend money on foreign aid for humanitarian reasons, but that choice would be made with as much knowledge on the topic as possible. Finally, the answer to the research question is relevant to societies in both donor and recipient countries. It could influence how much tax money is spend, if and how the economy benefits or how much money is received. These amounts can influence daily lives, for example through export-related jobs or through humanitarian improvements in recipient countries. For all these perspectives is true that, although this research focusses on the United States as a donor, similar results are likely for other developed countries as they engage in similar relations with recipient countries. Nevertheless, the methodology used in this research restricts the scope to only include the United States as a donor.

Results for the United States are relevant both inside and outside the United States. The United States has the largest development aid budget on earth, which makes results highly relevant for recipient countries, as they are affected by these results more than by results for any other donor. Yet results are also relevant for donor countries, because if even the largest donor on earth experiences positive effects from donating aid, strongly diminishing returns are not likely to occur any time soon for other donors.

In order to prevent endogeneity issues, a difference-in-difference analysis is applied, using being a 'focus country' in the PEPFAR program as a treatment, since these countries received substantially more aid in the treatment period. A control group is formed by matching treated countries to similar non-treated countries. Eventually, results show the statistically significant effect that countries in the treatment group experienced a 42% stronger increase in US exports to the recipient country during treatment period than countries in the control group. For US imports, no significant effect could be found for donated aid in the treatment period.

This thesis will start with a review of theoretical and empirical literature already available on this topic. First, literature on the gravity model will be reviewed. This is the model that is almost always used to estimate bilateral trade flows and that is also the basis for this research. Next, literature specifically focussed on the relation between foreign aid and trade will be analysed. This analysis will lead to hypotheses regarding the research question of this paper. After the literature review, the data used in this thesis and its sources will be explained. This is followed by a section in which the methods that are used to answer the research question will be discussed. The results of the research are published in the results section and will be elaborated upon in this section. Finally, a conclusion is reached regarding the main research question.

2. Literature Review

2.1 Foreign Aid

First of all, it is important to shortly introduce the concept foreign aid. Foreign aid is defined in the Merriam-Webster dictionary as: "*assistance (such as economic aid) provided by one nation to another".* In this paper, foreign aid will be used to refer to economic aid, rather than for example military aid. A lot of research is conducted on the topic of this economic foreign aid. Academics look at the reasons for giving aid, as well as the effects of foreign aid. Aid is obviously not randomly assigned, as generally countries in need would receive more aid than developed countries. However, other reasons might also play a role, such as political preferences and strategic interests. Such research is also relevant for academics looking into the effects of foreign aid, as the outcomes of research looking at motivations for donors might influence the estimation methods that can be used to estimate the effects. There are many effects that can be studied. These can include poverty levels, economic growth, wealth inequality and migration. In addition, the effects of foreign aid on trade flows can be studied, as will be done in this paper.

In order to be able to study this relation, it is important to define what will be considered as foreign aid. In this paper, foreign aid will be the Official Development Assistance (ODA) as determined by the Organization for Economic Co-Operation and Development (OECD). ODA is commonly used to measure foreign aid and it enables the use of reliable and easily accessible data from the OECD. The OECD definition of ODA reads: "*government aid that promotes and specifically targets the economic development and welfare of developing countries*".

Foreign aid can be both tied and untied. Tied aid must be spent in the donor country. Therefore, there are conditions which the recipient country has to oblige by in order to receive this aid. Untied aid does not come with these types of geographical spending restrictions, although there may of course be conditions regarding fraud prevention etc.

2.2 Gravity Model

The gravity model was introduced as a model for estimating international trade flows by Nobel Prize laureate Jan Tinbergen in 1962. It is called the gravity model because it was influenced by Newton's law of gravitation. The model assumes that bilateral trade volumes are explained by the size of the economies of both the exporting and importing country and by the distance between these economies. Tinbergen (1962) argues the amount of exports a country can supply is dependent on its economic size, the amount of imports a country can buy is also dependent on its economic size, and finally trade volumes are determined by transportation costs between the two countries. These transportation

costs are assumed to increase with distance between the trade partners. Of course, transporting goods to a neighbouring country is cheaper than transporting goods to a country on the other side of the world. This leads to the following basic equation for the gravity model:

$$F_{ij} = G * \frac{M_i M_j}{D_{ij}}$$

In this equation, trade flow *F* between countries *i* and *j* is dependent on constant *G*, respective economic sizes *M* and distance D between these countries.

From the very beginning, Tinbergen acknowledged the likelihood of improved accuracy of the model when introducing additional explanatory variables related to social, political and semi-economic factors. For example, Tinbergen included a model in his research that included dummies for being part of the British Commonwealth, being part of the Benelux or sharing borders. Over the years, academics have added various additional explanatory variables to the model. According to Anderson (2011), supplementing the model with additional proxies for trade frictions besides distance, such as a common language and political borders improves the fit of the model. The idea behind this is that the barriers to trade are lower when countries use the same language or have preferential trade agreements, for example.

At first, the gravity model was criticized for lacking a theoretical foundation. Empirically speaking, the model worked very well, but there was no theoretical literature to explain how the gravity model could be derived in a microeconomic way. Over time, academics did succeed in developing this theoretical foundation for the model and thus the model is now well accepted. For theoretical background on the gravity model, see the work of Anderson (1979) and Bergstrand (1985) who used models of monopolistic competition to derive the gravity model. Deardroff (1995) continued the development of the theoretical background by explaining how the model could be derived in the Ricardian model and the Heckscher-Ohlin model.

Nowadays, the gravity model is the most accepted model to estimate bilateral trade flows, although various estimation methods and control variables are used within the gravity model (Gómez-Herrera, 2012). Most of the time, the model is used to assess the impact of certain policy changes on bilateral trade. For example, the effect of trade agreements, investments, tariffs or new laws on trade can be estimated using the model. This is done by adding the policy change to the model as a variable. For this reason, the gravity model is also well suited to assess the effects of foreign aid on bilateral trade flows.

2.3 Relation between foreign aid and trade flows

Nilsson (1998) was the first author to use the gravity model to study the relation between aid and trade. Nilsson inferred from his model that on average, EU donors derive exports of $2.60 for every dollar they spend on foreign aid. This would mean that it is highly beneficial for developed nations to spend money on foreign aid, as these expenditures yield a higher return for domestic companies. Therefore, if this estimation is correct, governments would be wise to prioritise foreign aid, as opposed to what the current UK government is doing, which is cutting funding.

Theoretical background

When foreign aid is tied, there is at least a partial explanation for the increase in exports caused by donating foreign aid. The donated aid must be spend by the recipient country in the donating country, and so the donated aid returns to the donating country, only mostly into the pockets of exporters instead of the government. However this would not explain an increase of exports larger than 100%, like Nilsson found. In addition, not all aid is tied. In fact, starting in the 1990's various international organizations have lobbied against tied aid and the OECD members have agreed to untie trade from the early 2000's. This is mainly because, according to the OECD, tied aid is less effective and can increase costs of a project by up to 30 percent. This does leave the question open how aid can increase exports for the donor country when it is not tied but untied.

There are two main reasons in literature that can theoretically explain why an increase in foreign aid might lead to increased trade volumes between the donor country and the recipient country when aid is not tied. According to Silva and Nelson (2012), the first reason is that, assuming that foreign aid increases the income of inhabitants of the recipient country, the increased income levels would make it possible for the recipient country to import more. Foreign aid is assumed to increase income of inhabitants because it is often aimed at developing the economy, improving economic opportunities and reducing poverty. An increase in income would then enable people to consume more, and more consumption can usually not fully be supplied by domestic producers. The second reason Silva and Nelson mention is a collection of arguments, in the sense that for many reasons, a 'economic and political link' might be formed between the donor country and the recipient country. For example, the donor country might choose to donate money to projects in sectors in which it has a strong presence. This could happen when a country like the Netherlands, which has a strong water management sector, chooses to donate to flood prevention projects, which makes it more likely that the recipient country will trade with the Netherlands. Furthermore, established relations between the donor and recipient country might create more exposure to goods and entrepreneurs in the donor country for the recipient country, also increasing the likelihood of trade. These are just two possible

explanations, but a large number of reasons could be thought of when thinking of these sorts of links between countries.

Further empirical findings

Following Nilsson's paper in 1998, various academics have also tried to estimate the effects of foreign aid on trade between the donor country and recipient country using the gravity model. Every author has his/her own way of using the gravity model, trying to make the estimation as accurate as possible and trying to deal with possible issues like omitted variable bias and reverse causality. In addition, authors consider different samples. Most find a positive effect of foreign aid on exports from donor to recipients, although the coefficients found do vary. A select number of these papers will now be discussed. The papers that will be discussed were selected because they give the best overview of the studies that have been conducted over the past 20 years and because they have been published in the most well-respected journals.

In 2003, Wagner built upon the work of Nilsson by looking at the relation between aid and export expansion for all OECD countries, instead of only looking at the EU. Using the gravity model and pooled data, Wagner finds that OECD countries experience an increase of exports of 133% of foreign aid donated, on average. Wagner estimates that of those 1 dollar and 33 cents that comes back in exports for every dollar donated, 35 cents comes from exports of goods related to the project that was financed and 98 cents comes back to the donor indirectly. Furthermore, after looking into a possible lagged effect of foreign aid on export levels, Wagner notes: 'The trade benefit appears to be limited almost entirely to the year that the donation is made'. In an attempt to deal with endogeneity issues, Wagner first runs an OLS regression on donor imports, and then adds the residuals as a variable to the OLS regression on donor exports. Wagner assumes that unmeasured variables affect imports as they same way as they would effect exports.

Martínez-Zarzoso, Klasen, Nowak-Lehmann, and Herzer (2009) follow Nilsson and Wagner in using the gravity model to explore the relation between aid and trade, as they argue it is well suited to study this relation because of the ability to control for variables such as distance and language. However, Martínez-Zarzoso, Klasen, Nowak-Lehmann, and Herzer only study foreign aid donated by Germany, and they consider a longer period of time than previous studies have done. In addition, they estimate a relation using the Dynamic Ordinary Least Squares method, as they believe it is one of the options to prevent endogeneity issues. In addition, they also control for aid given by other European countries, as they believe it may affect gains for Germany because of the similar donation patterns between the countries, as opposed to donations from the US or Japan. Eventually, Martínez-Zarzoso, Klasen, Nowak-Lehmann, and Herzer find that German exports increase by 105% to 150% of foreign

aid donated. Interestingly, they also find strong evidence that foreign aid donated by other European countries strongly reduces the positive effects on German exports. Apparently, for Germany positive effects can be crowded out. Furthermore, after running Granger-Causality tests, Martínez-Zarzoso, Klasen, Nowak-Lehmann, and Herzer also find evidence that indicates: 'long-run causality is uni-directional from aid to exports'.

Quite some research into the topic focuses not on foreign aid as a whole, but on Aid for Trade (AfT). Aid for Trade is a WTO-initiative aimed at helping developing countries build trade capacity and infrastructure. Seeing as the goal of foreign aid that falls under AfT is to increase trade possibilities for the recipient country, research into the effects of AfT on trade volumes is directly related to the goal of that aid. Aid in general, on the other hand, also includes things like humanitarian aid, which is not primarily aimed at increasing trade. Brazys looked into the relation between AfT and trade volumes twice using the gravity model. In 2010, Brazys studied the effects of AfT donated by the United States, and found that AfT increased recipient country exports to the US, but not to the rest of the world. In 2012, Brazys studied the effects of AfT donated by 19 different OECD donors on trade volumes. In this paper, Brazys finds that there is considerable variation between AfT programs from different countries, as some don't have a significant effect on recipient country exports and others do, presumably due to differences in program design and implementation. In 2012, Brazys found similar results for the US AfT program, meaning that AfT donated by the US increases the recipient country exports to the US, in other words US imports. Brazys looked for endogeneity by testing recipient exports against general aid, and concluded based on the results that endogeneity was not present with regard to reverse causality. However, this does not rule out omitted variable bias. Nevertheless, AfT is only a part of the total foreign aid donated by the US, so results might be different in the first place when considering total foreign aid.

One of the more recent papers published in a well-respected journal is by Nowak-Lehmann et. al (2013). This paper focuses specifically on recipient exports to donor countries, in other words the imports of donor countries from recipient countries. As described above, academics have found evidence of a positive effect for the exporting sector of the donating country, but this paper looks into the question if there could also be such an effect for the exporting sector of the recipient country. Nowak-Lehmann et. al again use a model based on the gravity model, using cointegration estimators to try and control for endogeneity bias. They look at all OECD members as donators and all recipient countries found in the OECD database. They find that the effect of aid on recipient countries' export is insignificant. This suggests the export sector in recipient countries is not benefiting from the aid, unlike the export sector in the donating country.

All in all, the issue of the effects of aid on trade has been studied using the gravity model by various academics over the past two decades, yet every paper has its own methods and angles. There is not yet a consensus on what the best method is to deal with possible endogeneity issues, although all papers do use models based on the gravity model. Furthermore, there is no recent paper that specifically studies the effect of total foreign aid donated on trade for the United States as a donor country.

2.4 Hypotheses

Nevertheless, based on previous findings in the literature, it is possible to formulate hypotheses for the research question in this paper. These previous findings do not necessarily have to be true for the United States, since its economy could be structured differently, its development aid policy could have different aspects and a large number of other possible reasons, however since the findings in the existing literature do usually focus on developed, Western countries in modern times, similar results are expected.

Hypothesis 1: *Higher levels of aid donated by the United States to recipient countries cause higher levels of US exports to the respective recipient countries.*

Hypothesis 2: *Higher levels of aid donated by the United States to recipient countries have an insignificant effect on US imports from the respective recipient countries.*

3. Data

The data for this study comes from multiple databases. Data on foreign aid, or Official Development Assistance, are collected from the OECD Development Database on Aid. This database includes ODA statistics for all OECD members, including the United States. The database contains data on both ODA disbursements and ODA commitments. This study will use the data on ODA disbursements, as the actual transfer of funds is studied, rather than the promise of funds. The ODA disbursements are reported in current US dollars and are available from the year 1960 up to and including the year 2019.

Data on bilateral trade flows, both exports and imports, comes from the UN COMTRADE database. Data on GDP, GDP per capita and population comes from the World Bank. The next data source is used for the other control variables that originate from the gravity model: distance, language, common border and colonial relationship. Data for these variables comes from the Gravity database of the Centre D'Etudes Prospectives Et D'Informations Internacionales (CEPII). This database provides information necessary for the use of gravity model on all existing country pairs worldwide and is widely used by academics when studying a topic with the help of the gravity model.

Data on the budget of the Presidents Emergency Plan for AIDS Relief (PEPFAR) program that will be used for the difference-in-difference analysis comes from the United States Foreign Assistance Dashboard. Data for the years 2004-2008 will be used and includes all PEPFAR recipients.

For this study, data from the sources above will be used for the years 1999-2008 for Cote d'Ivoire, El Salvador, Eritrea, Guyana, Haiti, Kenya, Malaysia, Mali, Mozambique, Sri Lanka, Tanzania, Trinidad & Tobago and the United States. This is caused by the methodology of this study.

The only exception is data used for matching countries in the treatment group to similar countries in order to create a reliable control group. For this purpose, data from 2003 was used for all countries that received aid from the United States in that year according to the OECD Development database, except if there was no accurate information on GDP and population during that time, which is mainly true for countries that were involved in conflict, such as Iraq. The remaining 102 countries are specified in the appendix. Data on GDP and population from the World Bank and data from the CEPII database were used for these countries.

4. Methodology

The methodology section will start with a description of the equation that is derived from the gravity model and that will be used as the basis for this study. This is followed by a discussion of the issues that might arise when using this equation, after which a solution will be proposed through the use of the PEPFAR program as a treatment for a difference-in-difference analysis. Countries in the treatment group will then be matched to create a similar control group and equations are specified that can be used for an estimation. Finally, equations that will act as a robustness check and correlation estimation are discussed.

4.1 Basic equation

As mentioned before, this study will use the gravity model as the basis for the analysis. This general gravity model used is based on the model as used by Lehmann et al. (2013) and is only slightly altered due to the differences in estimation methods and variables of interest. The equations are as follows:

1)

$$\ln X_{it} = \beta_0 + \beta_1 \ln Aid_{it} + \beta_2 \ln Y_{USt} + \beta_3 \ln Y_{it} + \beta_4 \ln YH_{USt} + \beta_5 \ln YH_{it} + \beta_6 \ln Dist_i + \beta_7 ComLang_i + \beta_8 ComBord_i + \beta_9 \text{FormCol}\, Y_i + \varepsilon$$

2)

$$\ln I_{it} = \beta_0 + \beta_1 \ln Aid_{it} + \beta_2 \ln Y_{USt} + \beta_3 \ln Y_{it} + \beta_4 \ln YH_{USt} + \beta_5 \ln YH_{it} + \beta_6 \ln Dist_i + \beta_7 ComLang_i + \beta_8 ComBord_i + \beta_9 FormCol_i + \varepsilon$$

Equation 1 has US exports to country i in year t in thousand current US Dollars as dependent variable whereas equation 2 has US imports from country i in year t in thousand current US Dollars as dependent variable. Trade flows are separated into these two equations in order to see the possibly different effects of donated aid on imports and exports.

The right hand side of both equations are identical. Y_{USt} indicates US GDP in year t in thousand current US Dollars, whereas Y_{it} indicates the GDP of country i in year t in thousand current US Dollars. YH_{USt} is GDP per capita in year t for the US in thousand current US Dollars, YH_{it} is GDP capita in year t for country I in thousand current US Dollars.

$Dist_i$ is the distance from the US to country i, measured as the population-weighted distance between the most populated cities in kilometres. This measurement system is better than using

distance between countries' capitals or countries' most populated cities because this way, a country closer to the US East Coast will not have a much shorter distance in the data than a country that is closer to the US West Coast. For example, Asian countries do not have to travel the entire distance to the US East Coast to travel with the US, as they can trade with the US through West Coast cities such as Los Angeles.

Aid_{it} is the aid donated by the US to country i in year t as reported by the OECD as ODA in thousand current US dollars. Taking the natural log here potentially causes issues, because aid can sometimes take the value of 0, and the natural log of 0 is not defined. The solution for this problem will be discussed further on in the methodology section.

$ComLang_i$, $ComBord_i$, $FormCol_i$ are dummy variables that serve as control variables from the gravity model. $ComLang_i$ is 1 when the US and country i share the official language, in this case English, and 0 when they do not share English as official language. $ComBord_i$ is 1 when the US and country i share a border, and 0 when they do not. $FormCol_i$ is 1 when the US and country i have a colonial history and 0 when they do not.

4.2 Issues

Equations 1 and 2 above make it possible to run OLS regressions to estimate the effect of aid donated by the United States on exports and imports to and from the recipient country and data is available for many recipient countries during multiple decades.

Despite these possibilities, running an OLS regression could possibly cause endogeneity issues. First of all, endogeneity issues may arise due to omitted variable bias. For example, good or bad political relations with the United States may influence both how much foreign aid is donated to a country and how much trade exists between the US and that country.

Secondly, reverse causality is a possible issue. In this paper, the effect of aid donated on trade volumes is studied, however this does not tell us whether large trade volumes cause aid to be donated. For example, the United States (or any donating country) might be more inclined to assist countries which are already larger trading partners. Stimulating development in those countries could potentially be more beneficial to the United States itself, as the United States depends more on the economies in those countries.

As we have seen in the literature review, there is not yet a consensus on how to deal with these issues. For this reason, this paper will suggest a new approach using a difference-in-difference strategy. If this strategy yields similar results in comparison to the already existing literature, this paper will reinforce existing theories on the topic. However, if this strategy yields very different results in

comparison to existing literature, the need for a closer look into the different strategies on the issue could grow larger.

4.3 Difference-in-difference

This paper will utilise a difference-in-difference method, in which a group of countries have been treated while another group of countries has not been treated, the control group. Treatment will be being a 'focus country' in the US PEPFAR program.

The President's Emergency Plan for AIDS Relief (PEPFAR) program was launched by the US in 2004 to combat the AIDS pandemic in developing countries. 15 countries were selected as 'focus countries', meaning that these countries would receive the majority of humanitarian aid from the PEPFAR budget. These countries were selected on the basis of HIV/AIDS prevalence rates in the countries. The 'focus countries' were Botswana, Côte d'Ivoire, Ethiopia, Guyana, Haiti, Kenya, Mozambique, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Uganda, Vietnam, and Zambia. The PEPFAR program is still active in 2021, however after 2008 the program shifted away from the 'focus country' approach. All in all, the 'focus countries' thus received substantially more aid between 2004 and 2008 for exogenous reasons, namely HIV/AIDS prevalence rates. Using being a focus country in the PEPFAR program could solve endogeneity problems for the following reasons. Since being selected as a focus country is decided by looking at HIV/AIDS prevalence rates, we assume that this treatment is not influenced by any unobserved value that could also influence the dependent variables of trade flows. In addition, this also limits the risk of reverse causality as existing trade flows do not decide whether a country is 'treated', but HIV/AIDS prevalence rates do.

Nevertheless, we cannot fully rule out endogeneity issues. There are still ways that one can think of that might influence aid volumes. For example, countries with high HIV/AIDS prevalence rates but bad relations with the United States might not be selected for the PEPFAR program. In addition, not all Official Development Assistance is related to the PEPFAR program, so an increase or decrease in aid might also have other causes, however for this study, we do make the assumption that the trend breaking increase in aid is caused by the PEPFAR program. Finally, reverse causality cannot fully be ruled out, as important trading partners for the US might still receive some benefit over less important trading partners. Although not perfect, using the PEPFAR program as a treatment is still very helpful, as it makes the chances of endogeneity issues much smaller, since we do have a clear exogenous reason why donated aid for some countries is increased so strongly in contrast to others.

A control group needs to be identified to use the difference-in-difference method. This was done using coarsened exact matching (cem). In coarsened exact matching, data is coarsened, after which an exact match is found. Essentially, with the cem-method, countries are divided into groups for each variable, and a match is found when another country is in the same group for every single variable. In the case of dummy variables there are two groups, one for countries with dummy variable being 1, and one for countries with dummy variable being 0. In the case of continuous variables, there are usually multiple groups with certain intervals. For example, if age would be a variable, groups could be formed for people being 0 to 10 years old, 10 to 20 years old, 20 to 30 years old and so on. This way, we do not need an exact match for a variable like GDP, which would be impossible to find.

Focus countries were matched to countries who were not included in the PEPFAR program based on country characteristics in 2003, just before PEPFAR commenced in 2004. Countries in the dataset were dropped if they did not receive any aid in 2003 and if there was no accurate information on GDP and population at the time. Focus countries were matched to countries that had similar numbers of population, GDP, weighted distance to the US and were in the same category concerning the dummy variables common language, colonial relationship and common border. These are the control variables found in the general equations. This way, one can know that before the introduction of the PEPFAR program, treatment group and control group were similar on relevant characteristics.

Not all focus countries could be matched to a non-treatment country using the cem-method, because there were not always comparable countries. Take for example Nigeria, which is a focus country in the PEPFAR program. There is no country with a similarly large population and GDP at approximately the same distance from the US that also has English as an official language. In an attempt to increase the size of the treatment and control group, the cem-method was applied with larger intervals for the variables, however this yielded matches with very large differences, which cannot reliably be compared. Therefore, not all focus countries will be considered in this paper. This limits the size of the treatment and control groups, but it makes the use of the difference-in-difference method more reliable and appropriate as there are more assurances that treatment and control groups are similar before treatment.

Eventually, the following countries were matched:

Table 4.1: Matched country pairs

Treatment group	Control group
Guyana	Trinidad & Tobago
Haiti	El Salvador
Cote d'Ivoire	Mali
Kenya	Eritrea
Tanzania	Malaysia
Mozambique	Sri Lanka

From data on HIV/AIDS prevalence rates, we can see how these differ between the treatment group and the control group when focus countries were decided, and thus what causes these countries to be in either the treatment or the control group. This data can be found in table 4.2.

Table 4.2: HIV/AIDS prevalence rates for countries in data in 2003

Treatment group	HIV/AIDS %	Control Group	HIV/AIDS %
Guyana	1.43%	**Trinidad and Tobago**	0.97%
Haiti	2.6%	**El Salvador**	0.44%
Mozambique	10.18%	**Sri Lanka**	0.01%
Cote d'Ivoire	4.88%	**Mali**	1.16%
Tanzania	7.87%	**Malaysia**	0.24%
Kenya	8.17%	**Eritrea**	0.81%

Source: OurWorldInData

Since the six countries on the left are in the treatment group, they received funding from the PEPFAR program. In table 4.3, the budget for the bilateral aid parts of the PEPFAR program can be found from 2004 to 2008. As can be found in the table, this budget increased throughout the years. Importantly, the six countries in the treatment group for this paper received only a part of this budget, as they are only a part of the fifteen 'focus countries' that received the majority of the bilateral budget up to and including 2008.

Table 4.3: PEPFAR Budget in the years 2004-2008

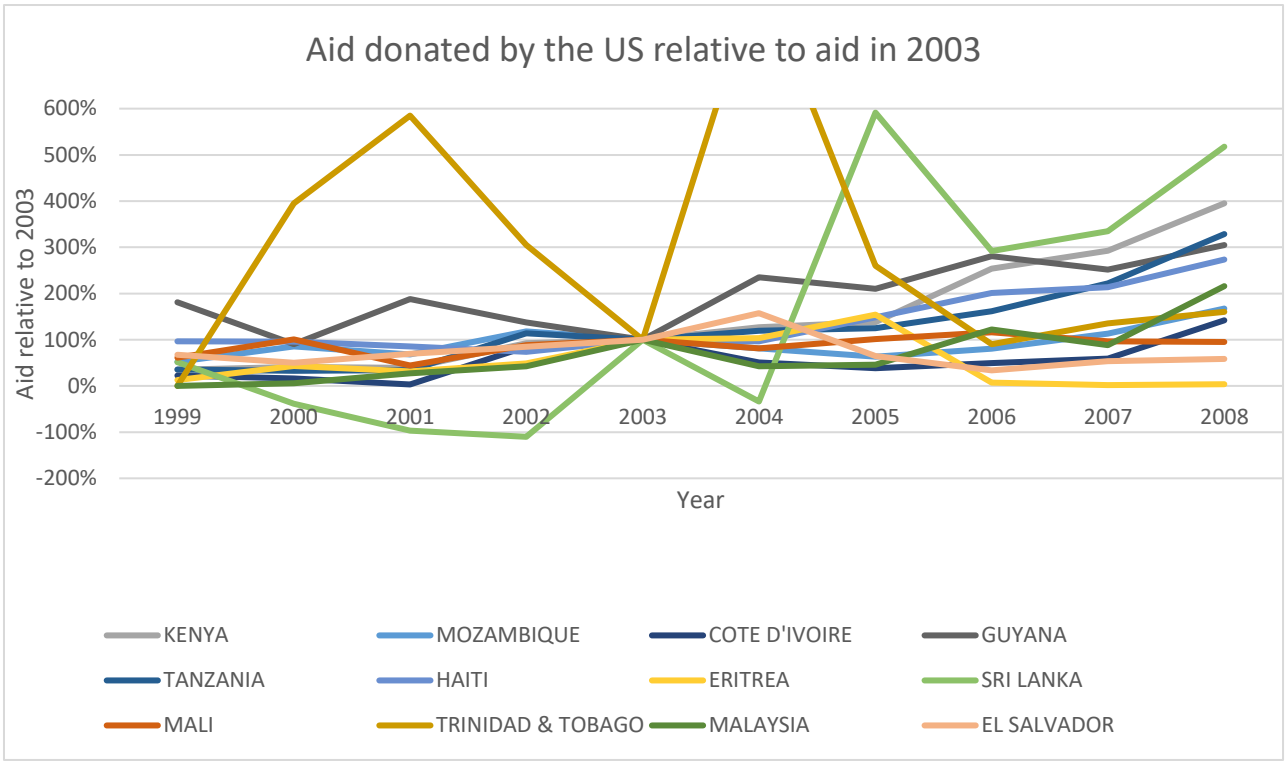
Year	PEPFAR Bilateral Budget in millions USD
2004	1643
2005	2263
2006	2654
2007	3699
2008	5028

Source: Congressional Research Service

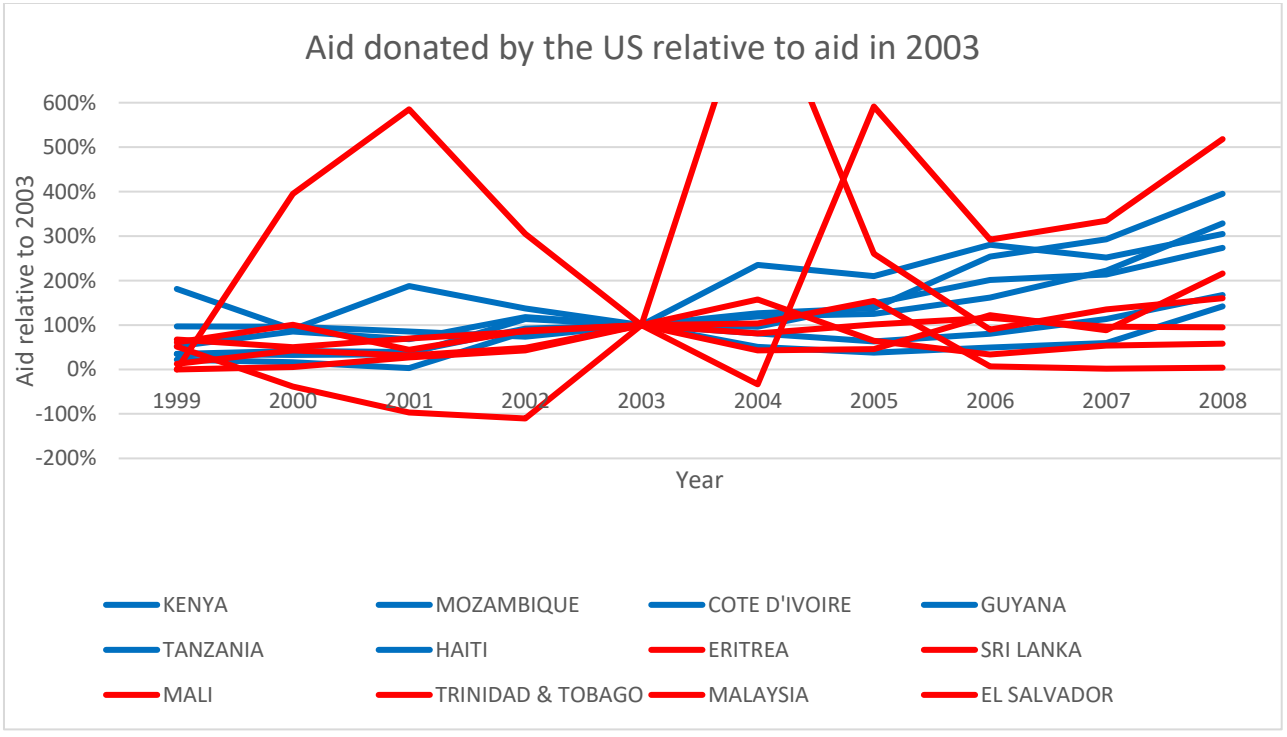
4.3 Treatment: PEPFAR program

Since we assume countries in the treatment group to (relatively) receive substantially more aid than the control group after being selected as a focus country in the PEPFAR country, it is important to check whether this is actually the case. In order to do this, three groups of graphs are used displaying different information. In each group of graphs, similar information is shown, however first for individual countries, then for individual countries in their group color and finally for the treatment and control group as a whole.

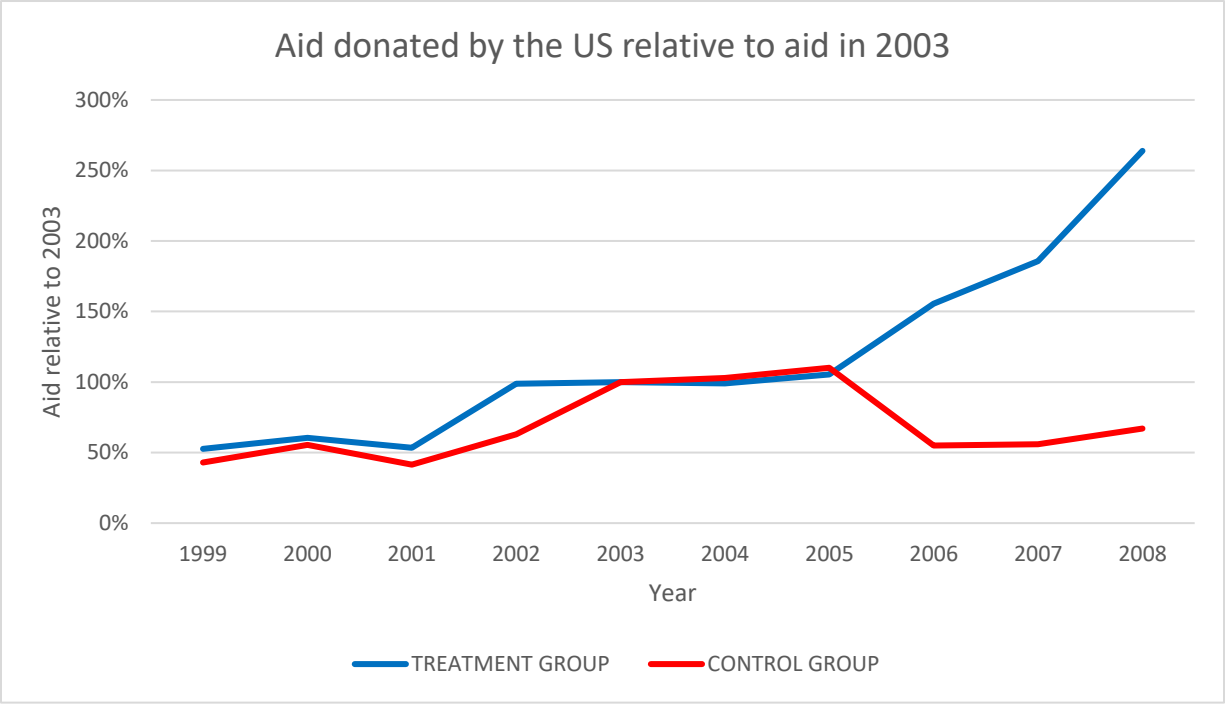
In graph 4.1, we see the amount of aid donated to countries in the treatment and control groups relative to 2003, the year before the PEPFAR program was introduced. In graph 4.2, the same lines are displayed as in graph 4.1, however lines for the treatment group are blue and lines for the control group are red. In the treatment group we see an increase in aid donated by the US relative to 2003 for all countries ranging from a 142% increase in 2008 for Cote d'Ivoire to a 395% increase in 2008 for Kenya. However, we also find that some countries in the control group had a larger increase relative to 2003 than some countries in the treatment group. These include Sri Lanka, Malaysia and Trinidad and Tobago. Nonetheless, this can be explained by looking at total aid donated by the US to these countries and aid donated per capita. In graph 4.3 we find that the treatment group in total started to receive much more aid than the control group relative to 2003, especially starting from 2005.



Graph 4.1: Aid donated by the US relative to aid donated in 2003 by individual country



Graph 4.2: Aid donated by the US relative to aid donated in 2003 by group color



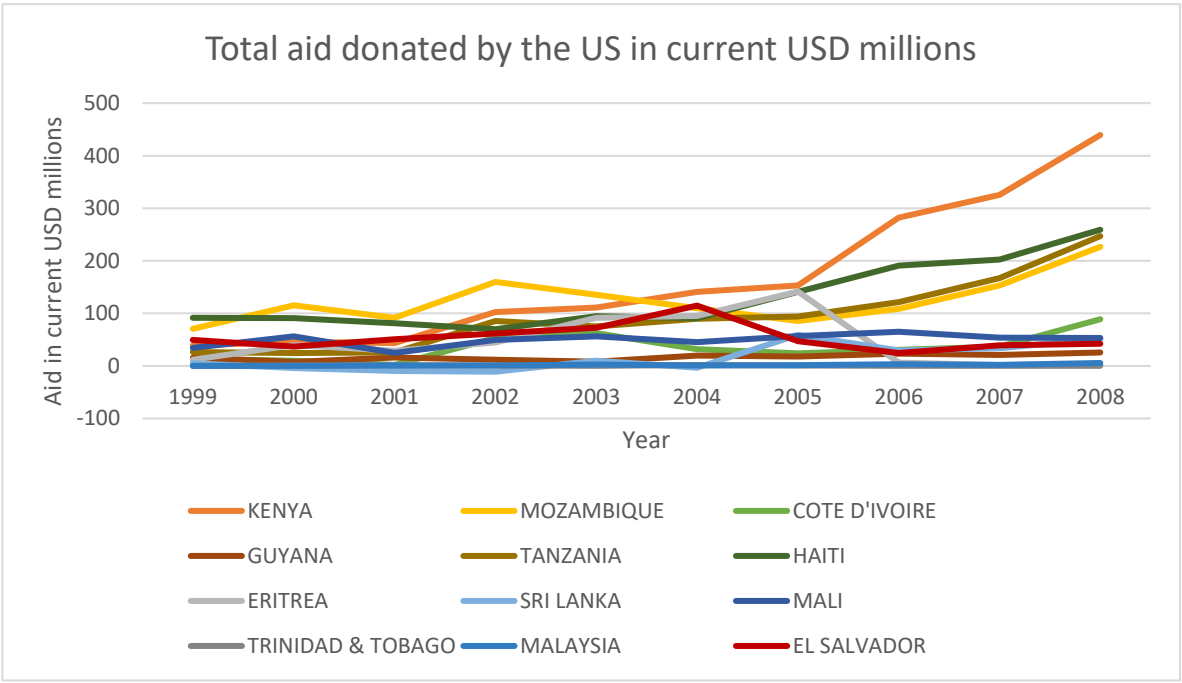
Graph 4.3: Aid donated by the US relative to aid donated in 2003 by group

In graph 4.4, total aid donated by the US between 1999-2008 can be found for all countries in the treatment and control group. In graph 4.5, we again find the same lines, but in blue for treatment group countries and in red for control group countries. The countries in the treatment group mostly get more total aid than the countries in the control group. It makes sense that a country like Kenya receives more than a country like Trinidad and Tobago due to their sizes, however overall both groups are relatively similar in size because of the matching methods applied earlier. Therefore, it is remarkable that in 2008 all countries in the treatment group, with the exception of Guyana, receive much more aid than the countries in the control group, whereas this large difference did not exist before treatment started. In addition, in graph 4.6 we see that the treatment group as a whole has always received more aid than the control group, but that this gap has widened significantly in the treatment period.

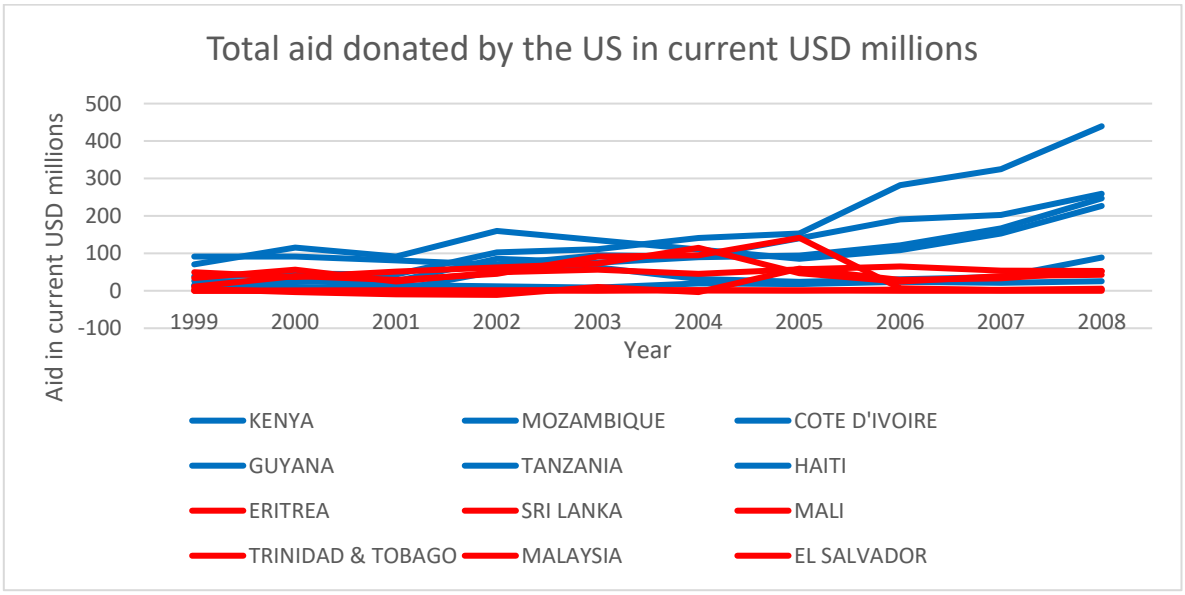
With graphs 4.4 and 4.5, we can also explain why Sri Lanka, Malaysia and Trinidad and Tobago have volatile but sometimes very large increases in aid relative to 2003, as we found in graph 4.1. For these countries, total aid donated is extremely low. In fact, it is so low that we can barely see their lines in graphs 4.4 and 4.5. Due to their 2003 values for aid being very low, a small increase can lead to a large relative increase. For example, Trinidad and Tobago received 0.2 million USD aid in 2003. This rose to 1.79 million USD in 2004, which gives a 895% increase in aid. In the years after, aid dropped back to numbers between 0 and 1 million USD. Therefore, these relatively small changes in total aid donated caused large percentual changes. In addition, from graph 4.7 we know that Sri Lanka, Malaysia

and Trinidad and Tobago received the least aid per capita in 2008 from all countries and that aid per capita has been very low for these three countries throughout the years in the data.

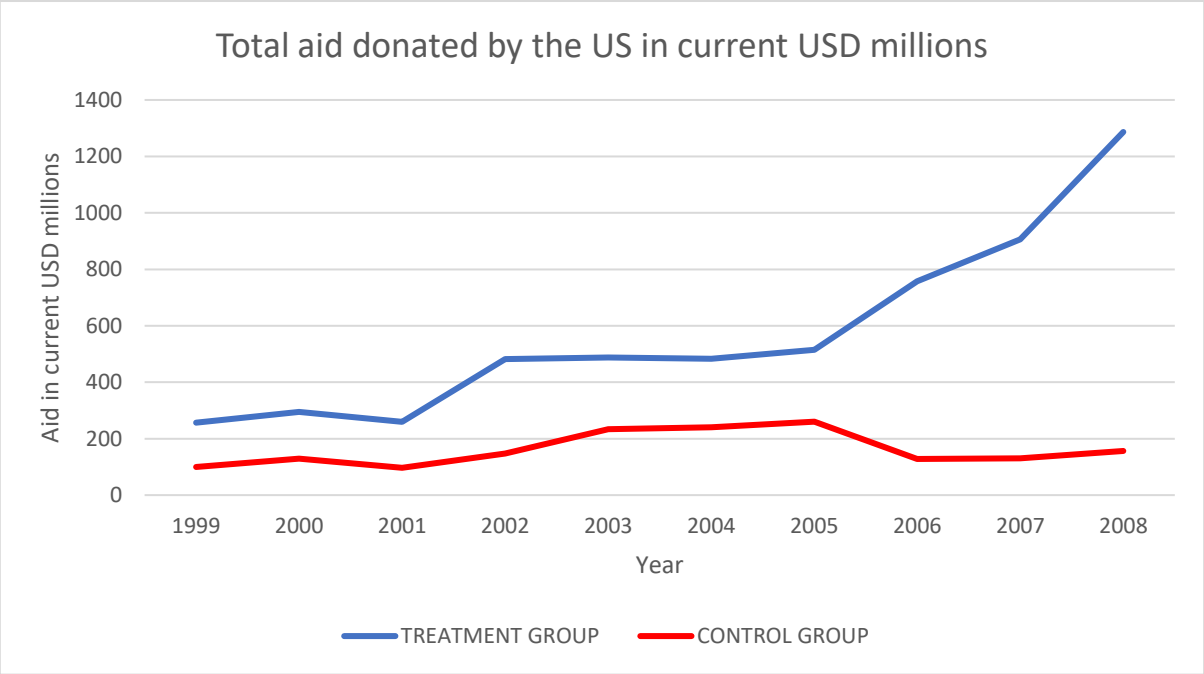
The fact that Guyana eventually still receives less total aid than Mali and El Salvador is not difficult to explain. Guyana is by far the smallest country in the sample with regard to population and GDP size. Relatively speaking though, in 2008 Guyana did receive 305% more aid than in 2003, which is much more than Mali with 95% of aid received in 2003 and El Salvador with only 45% of aid received in 2003, as can be found in graph 4.1. In addition, Guyana receives the most aid per capita, as can be seen in graph 4.7.



Graph 4.4: Total aid donated by the US in current USD millions by individual country



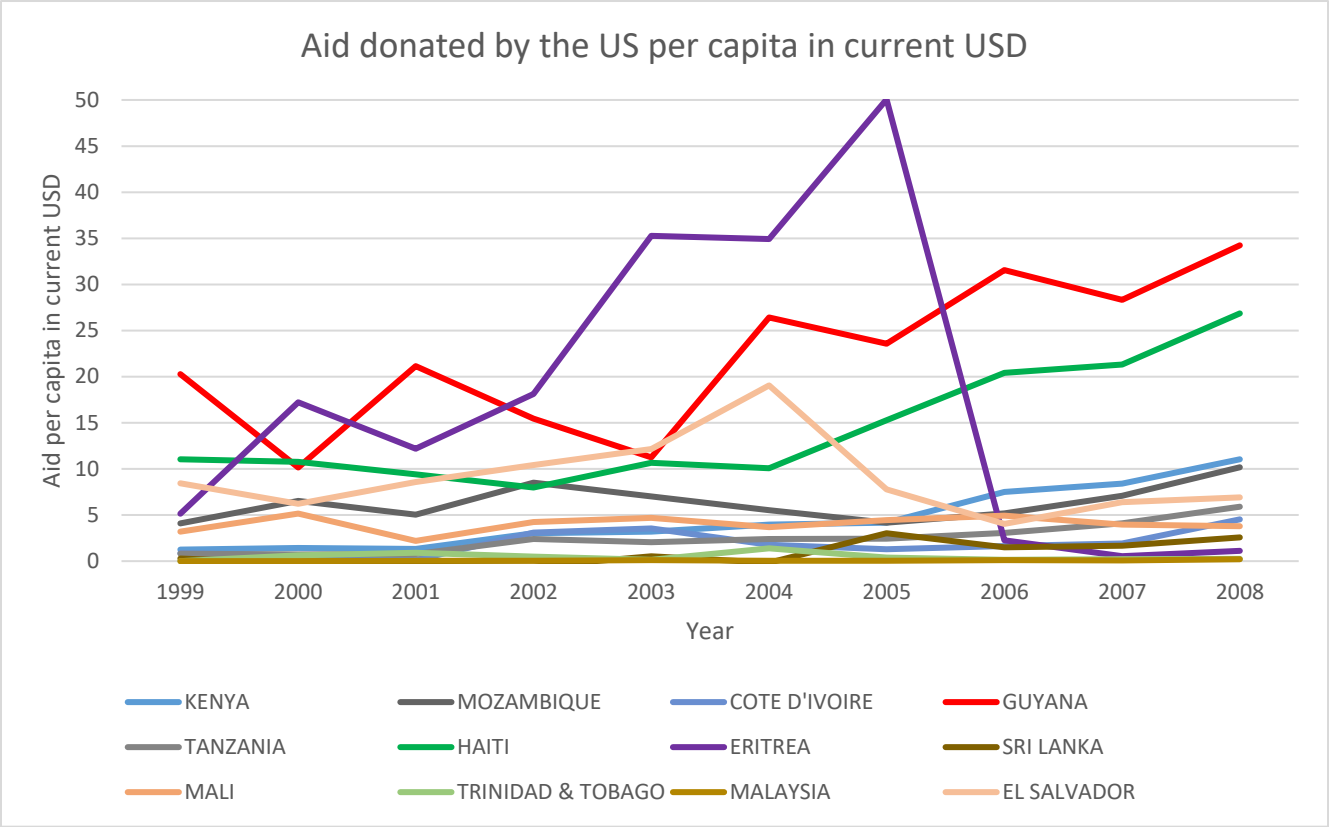
Graph 4.5: Total aid donated by the US in current USD millions by group color



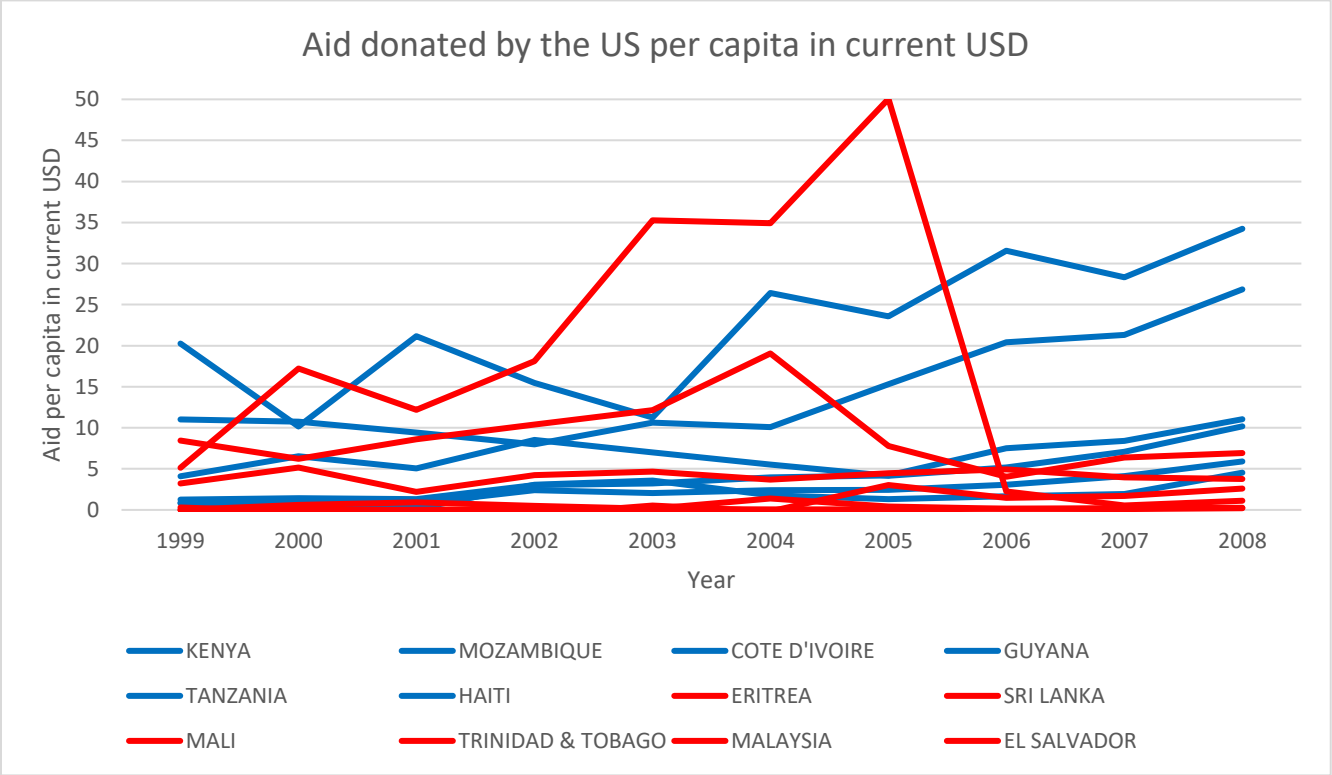
Graph 4.6: Total aid donated by the US in current USD millions by group

In graph 4.7, we find aid donated by the US per capita for all countries in our sample, and as before, graph 4.8 was added to show differences between treatment and control groups. Before the start of treatment in 2004, no group clearly receives more aid per capita. However, in the years after treatment has started, the treatment group clearly starts coming out on top. Eventually, only El Salvador still manages to stay higher than countries from treatment group. Yet, as we have seen in graph 4.1 , El Salvador started receiving less aid after 2003, rather than more like the treatment group. Its position is thus more related to its position before treatment rather than being evidence of issues with treatment. The same goes in part for Eritrea, which already received far more per capita than the treatment group before treatment started in 2004. The sudden drop Eritrea makes in all graphs has an external reason. Eritrea continued to trade with the US, but did not longer accept any foreign aid from other governments from 2006 (Sanders, 2007).

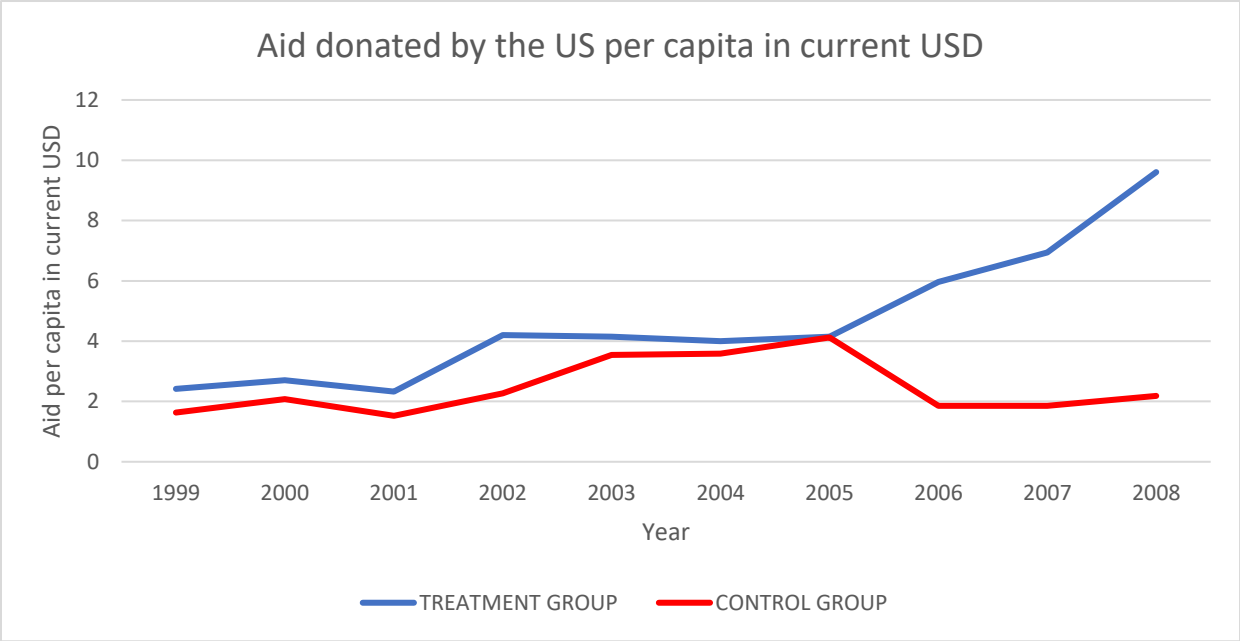
From graph 4.9 we can tell that the treatment group has always received more aid per capita than the control group, but that the difference between the two has grown a lot during the treatment period to the largest difference in 2008.



Graph 4.7: Aid donated by the US per capita in current USD by individual country



Graph 4.8: Aid donated by the US per capita in current USD by group color



Graph 4.9: Aid donated by the US per capita in current USD by group

All in all, we have found that the countries in the treatment group generally receive higher numbers of total aid received, higher numbers of aid per capita and larger increases in aid received in the years after 2003, especially starting from 2005, compared to the countries in the control group. From 1999 to 2003, although countries from the treatment group did mostly receive higher numbers of aid in comparison to countries in the control group, trends were similar and the differences were not very large, whereas during the treatment period this changed tremendously.

4.4 Difference-in-difference continued

Knowing this, it is now possible to proceed with the difference-in-difference analysis. We take equations 1 and 2 as a start and adjust it to our current dataset and methodology. Since none of the countries in the treatment and control groups have a former colonial relation with the United States or share a common border with the United States, we drop FormCol and ComBord from the equations. Since we use a difference-in-difference strategy, we include a dummy that indicates whether a country is in the treatment group or not ($Treatment$), instead of the continuous Aid variable, and a dummy variable that indicates whether we are in the treatment period or not ($Post$). In addition, an interaction variable is added. This interaction variable is the variable of interest, since we are interested in the effect of being in the treatment group on exports and imports in the treatment period, following the assumption that the increase in aid in the treatment period is not endogenous or caused by trade in earlier years.

3)

$$\ln X_{it} = \beta_0 + \beta_1 Treatment + \beta_2 Post + \beta_3 Treatment * Post + \beta_4 \ln Y_{USt} + \beta_5 \ln Y_{it} + \beta_6 \ln YH_{USt} + \beta_7 \ln YH_{it} + \beta_8 \ln Dist_i + \beta_9 ComLang_i + \varepsilon$$

4)

$$\ln I_{it} = \beta_0 + \beta_1 Treatment + \beta_2 Post + \beta_3 Treatment * Post + \beta_4 \ln Y_{USt} + \beta_5 \ln Y_{it} + \beta_6 \ln YH_{USt} + \beta_7 \ln YH_{it} + \beta_8 \ln Dist_i + \beta_9 ComLang_i + \varepsilon$$

Furthermore, country fixed effects will be used in this study. These fixed effects proxy for time-invariant characteristics. Often, the Hausmann test is used to decide whether fixed effects should be used. However, for panel data in the gravity model, estimation methods should include fixed effects, since the effects between trading partners are not random (Egger, 2000). There are many motives, like historical relations and geographical distances, that are time-invariant. This is the reason why variables like distance and colonial relationship are added to the gravity model. However, as panel data is used, fixed effects can be used to account for these time-invariant factors. This is almost universally applied in literature for similar studies, for example by Nowak-Lehmann et. al (2013). Not all academics use the same fixed effects methods. Some use importer and exporter-specific effects, while some use trading partner fixed effects. According to Cheng & Wall (2005), trading partner fixed effects are superior, which is a good thing for this study, since this is the only option considering the fact that we only look at the US and its trading partners. Since fixed effects are used, variables Treatment, Dist and ComLang are dropped. These do not vary over time. This gives the following equations:

5)

$$\ln X_{it} = \beta_0 + \beta_1 Post + \beta_2 Treatment * Post + \beta_3 \ln Y_{USt} + \beta_4 \ln Y_{it} + \beta_5 \ln YH_{USt} + \beta_6 \ln YH_{it} + \varepsilon$$

6)

$$\ln I_{it} = \beta_0 + \beta_1 Post + \beta_2 Treatment * Post + \beta_3 \ln Y_{USt} + \beta_4 \ln Y_{it} + \beta_5 \ln YH_{USt} + \beta_6 \ln YH_{it} + \varepsilon$$

Since equations 5 and 6 will not yield a result for the how much a certain increase in aid will affect exports and imports, but rather how much being in the treatment group in the treatment period

will affect exports and imports, regressions based on equations 1 and 2 will also be run in order to estimate the correlation between aid and trade flows. These regressions will also serve as a robustness check with regard to the regressions run based on equations 5 and 6. As the use of country fixed effects is preferred in this field of study, equations 1 and 2 will be adjusted to reflect this method. Effectively, time-invariant variables are removed, similar to what was done for equations 5 and 6:

7)

$$\ln X_{it} = \beta_0 + \beta_1 \ln Aid_{it} + \beta_2 \ln Y_{USt} + \beta_3 \ln Y_{it} + \beta_4 \ln YH_{USt} + \beta_5 \ln YH_{it} + \varepsilon$$

8)

$$\ln I_{it} = \beta_0 + \beta_1 \ln Aid_{it} + \beta_2 \ln Y_{USt} + \beta_3 \ln Y_{it} + \beta_4 \ln YH_{USt} + \beta_5 \ln YH_{it} + \varepsilon$$

In 7 out of 120 observations, aid does not have a positive value, which means we cannot take the natural log of aid in those cases. As is described by Silva & Nelson (2012), 'when foreign aid is zero, a common practice in the literature is to add a small value before taking logs'. Therefore, zero values are replaced by 0.0001. This way, all observations can be included. According to Silva & Nelson (2012), this does not significantly affect results.

5. Results

The results of the difference-in-difference regressions run based on equations 5 and 6 are as follows:

Table 5.1: Panel Data Regression Results (Difference-in-difference fixed country effect)

Variables	*US Exports*	*US Imports*
Treatment period($Post$)	-0.387	0.215
	(0.192)	(0.203)
Interaction variable Treatment group ($Treatment$) & Treatment Period ($Post$)	0.356**	0.014
	(0.136)	(0.144)
US GDP(Y_{USt})	13.670	-14.662
	(11.229)	(11.860)
Recipient GDP(Y_{it})	0.495	-0.561
	(1.049)	(1.108)
US GDP per capita (YH_{USt})	-16.725	18.679
	(14.138)	(14.932)
Recipient GDP per capita (YH_{it})	-0.102	0.787
	(1.029)	(1.086)
Constant	-250.604	391.926
	(205.891)	(217.460)
Fixed Effects	Yes	Yes
Observations	120	120
R^2	0.309	0.268

Standard Errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The results of the regressions run based on equations 7 and 8 are as follows:

Table 5.2: Panel Data Regression Results (Fixed country effect)

Variables	*US Exports*	*US Imports*
Aid donated by the US	0.024	0.007
(Aid_{it})	(0.017)	(0.017)
US GDP(Y_{USt})	8.685	-21.743
	(9.938)	(10.300)
Recipient GDP(Y_{it})	0.755	-0.492
	(1.077)	(1.116)
US GDP per capita (YH_{USt})	-9.999	28.257
	(12.157)	(12.600)
Recipient GDP per capita	-0.510	0.692
(YH_{it})	(1.059)	(1.098)
Constant	-164.265	419.585
	(182.803)	(289.471)
Fixed Effects	Yes	Yes
Observations	120	120
R^2	0.274	0.259

Standard Errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The main aim of this paper is to study the effects of development aid donated by the United States on trade flows between the United States and the recipient country. A difference-in-difference method has been applied to prevent omitted variable bias and reverse causality issues. Therefore, the main variable of interest in the regressions based on equations 5 and 6 is the interaction variable for being in the treatment group and treatment period. This variable indicates the effect of being a 'focus country' in the PEPFAR program during the treatment period on both US exports and US imports in relation to the recipient country. First, the results of the regressions based on equations 5 and 6 will be discussed, which are shown in table 5.1. Next, the results of the regressions based on equations 7 and 8 will be discussed, which are shown in table 5.2. These results act as a robustness check for the results of the regressions in table 5.1, in addition to estimating the correlation between aid and trade flows.

5.1 Difference-in-difference results

The results display a statistically significant positive effect for being in the treatment group during the treatment period on US exports to the recipient country. Since the natural logarithms of the dependent variable has been taken, the value of the interaction variable in table 5.1 indicates that countries in the treatment group experienced a growth of US exports to them of 42.8% more than countries in the control group during the treatment period. Since the p-value is 0.01, which is lower than 0.05, this result is significant at a 5% significance level.

For US imports, on the other hand, the results indicate that being in the treatment group during the treatment period leads to only a 1.4% stronger increase in US imports from the recipient country. However, in contrast to the results for US exports, this value for the interaction variable is not statistically significant at a 5% significance level, since the p-value is above 0.05.

In the treatment period, which was 2004 to 2008, US exports were seemingly lower on average to countries in the data set, whereas US imports were seemingly higher on average. Again, however, these results are not statistically significant.

US exports seem to benefit from the growth of the US economy and the growth of the recipient country economy, as there is a positive sign for both US GDP and recipient country GDP. The sign for US GDP per capita is negative, just like the sign for recipient country GDP per capita is negative with regard to US exports. This would indicate that recipient countries import less from the US as their citizens or US citizens become wealthier per capita. Yet, all signs are only indications as none of the values are statistically significant at a 5% significance level.

For US imports, the opposite is true with regard to economic growth when comparing it with these values for US exports. US imports seem to decrease when the US economy or the recipient country economy grow, as can be seen from the negative signs in table 5.1 Growth of the economy per capita, however, does seem to have a positive impact on the size of US imports. This effect appears to be large particularly for the growth of US GDP per capita.

All in all, the only variable that is statistically significant at a 5% significance level is the interaction variable for being in the treatment group during the treatment period with regard to US exports.

5.2 Robustness check and correlation estimation

Regressions were also run based on equations 7 and 8. The results are shown in table 5.2. These results might suffer from endogeneity issues, however they serve to give us an idea of the correlation between aid and trade flows, in addition to serving as a robustness check for the results discussed in section 4.1.

To have an estimation of the correlation between aid and trade flows, the values of the variable Aid in table 5.2 are needed. Because the natural logarithms of both the dependent and the independent variables were taken, the results in table 5.2 indicate that a 1% increase in donated aid leads to a 0.024% increase in US exports to the recipient country, whereas a 1% increase in donated aid leads to a 0.007% increase in US imports. These seem like very small numbers, however one needs to take into account the fact that a 1% increase in donated aid constitutes a much smaller amount of money than a 1% increase in US exports, since the US dollar value of total donated aid is much smaller than the US dollar value of US exports for all countries. The same is true for US imports. Nevertheless, both values are not statistically significant at a 5% significance level.

No value in table 5.2 is statistically significant at a 5% significance level. Yet, the results are still relevant as a robustness check for the results in table 5.1. We expect the results in table 5.1 to suffer from more endogeneity issues, however it is good to check whether the obtained results are somewhat similar to the results obtained in table 5.2. Remarkably, all variables in relation to US imports and US exports have the same sign in table 5.1 as in table 5.2, although there are some differences in the weight of variables. The only variables that do not exist in both tables are donated aid, treatment period and the interaction variable. There is no comparable variable in table 5.2 for the variable treatment period from table 5.1. In table 5.2, we find positive signs for the effect of donated aid on both US exports and US imports. In table 5.1, we find positive signs for the effect of being in the treatment group during the treatment period. These two findings support each other, since we know that the treatment group has experienced a large increase in aid during the treatment period. All in all, although we do not find any statistically significant values in table 5.2, the results do not conflict with our findings in table 5.1.

5.3 Hypotheses

Having obtained the results, it is now possible to look back at the hypotheses that were formulated based on the literature review. These hypotheses were:

Hypothesis 1: *Higher levels of aid donated by the United States to recipient countries cause higher levels of US exports to the respective recipient countries.*

Hypothesis 2: *Higher levels of aid donated by the United States to recipient countries have an insignificant effect on US imports from the respective recipient countries.*

Using the difference-in-difference method, the findings of this study are consistent with the hypotheses. In the treatment period, which was used to prevent endogeneity issues, a statistically significant positive effect of donated aid on US exports was found. With regard to US imports however, no significant effect of donated aid could be found, whether it be positive or negative. A robustness check through an OLS regression did not yield any results that conflict with this conclusion.

6. Conclusion

This study has focussed on the following research question: 'What are the effects of development aid donated by the United States on trade volumes between the United States and recipient countries?'. A difference-in-difference method was applied in order to estimate the effects of aid donated on trade volumes in order to avoid endogeneity issues. The treatment group included countries which were a focus country in the PEPFAR aid program, whereas the control group included countries similar to the countries in the control group that were not a part of the PEPFAR aid program.

Four regressions were run in this study, two for US exports and two for US imports. These regressions were based on the Gravity Model, however they were modified in order to be workable suitable for the estimation methods used. The results yielded a statistically significant positive effect for being a focus country in the treatment period on US exports. Being in the treatment group during the treatment period led to a 42% stronger increase in US exports to the recipient country. For US imports, no significant effect could be found for donated aid in the treatment period. The regressions that were run to estimate the correlation between donated aid and trade flows did not yield statistically significant results, however the signs found for the variables in these regressions were consistent with the results found in the difference-in-difference analysis.

Limitations for this study include the fact that the treatment and control group were rather small, that endogeneity could not fully be ruled out through the use of difference-in-difference and the fact that findings for the US in the researched years are not necessarily true for other countries that donate development aid or for the US in years that were not included.

Future research could look into other methods to prevent endogeneity issues, or look into a similar difference-in-difference analysis for other donor countries or at other periods of time. Furthermore, more research into the effects of the design of development aid programs is desirable, rather than solely looking at the amount of money donated.

Overall, the findings of this study reinforce the existing ideas that donating development aid also benefit exporters in the donor country, whereas donating development aid does not increase exports from the recipient country to the donor country. Although this study has focussed on only one donor country and on a limited period of time, its findings are consistent with existing literature on other donor countries and at other time periods. Therefore, the answer to the research question of this paper adds to the evidence of the effects of development aid on trade flows.

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8. Appendix

Countries in the dataset used for matching:

Venezuela
Iran
Congo
Micronesia
Costa Rica
Panama
Nicaragua
Colombia
Honduras
Guatemala
Cuba
Dominican Republic
Jamaica
Belize
Ecuador
Peru
Mauritania
Senegal
Morocco
Cabo Verde
Bolivia
Paraguay
Gambia
Algeria
Moldova
Niger
North Macedonia
Benin
Tunisia
Croatia
Chile
Guinea
Burkina Faso
Argentina
Bosnia and Herzegovina
Albania
Togo
Guinea-Bissau
Liberia
Ghana
Sierra Leone
Egypt
Kyrgyzstan
Georgia
Kazakhstan
Lebanon
Central African Republic
Equatorial Guinea
Mongolia
Armenia
Chad
Turkmenistan
Gabon
Jordan
Afghanistan
Tajikistan
Uzbekistan
Syrian Arab Republic
Azerbaijan
Nigeria
Marshall Islands
Bangladesh
Oman
Angola
Nepal
Laos
DR Congo
Burundi
Yemen
Djibouti
Namibia
Uganda
Rwanda
Zambia
Philippines
Palau
Thailand
Timor-Leste
Malaysia
Cambodia
Madagascar
South Africa
Tanzania
Botswana
Turkey
Indonesia
Brazil
India
Mexico
China
Haiti
El Salvador
Guyana
Trinidad and Tobago
Cote d'Ivoire
Mali
Ethiopia
Pakistan
Kenya
Eritrea
Mozambique
Sri Lanka