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Foreign Aid's Impact on Income Inequality

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Abstract

Despite indications that inequality can have a large impact on development, little research on the relationship between foreign aid and inequality exists. The majority of the studies on the subject also focus on overall aid figures, thereby leaving the question of whether the purpose of aid matters unexplored. This study uses panel data on 116 countries over the time period 1972-2011 to focus on whether aid affects inequality, and in particular whether the effect in that case depends on the type of aid. Aid is therefore separated into four statistically valid categories: economic, social, reconstructional and residual. The results indicate that a relationship exists between all four categories of aid and inequality, and that the purpose of aid does matter. Economic and social aid show a positive relationship to inequality, while reconstructional and residual aid display a negative one.

Keywords: Inequality, Foreign aid, Panel data

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1. Introduction

In recent years, increased attention has been paid to the importance of aid efficiency. The Paris Declaration on Aid Effectiveness (2005), the Accra Agenda for Action (2008), and the Busan Partnership for Effective Development Cooperation (2011) (OECD 2012; OECD n.d.e) reflect a growing interest in the topic among donor countries. The trend can be noticed also among economists. Although interest in aid efficiency has been widespread within the economic field since the 1970's (Hansen & Tarp 2000), there seems to have been renewed focus on the topic after a recent study by Burnside and Dollar (2000) showed that aid has a positive effect on growth in the presence of good policies. The increased attention on the necessity of using aid money effectively is greatly needed. Despite the long history of foreign aid, around 1.3 billion people still live in absolute poverty¹ (World Bank 2012).

Economic research on aid efficiency is largely focused on aid's effect on growth. The basic theoretical foundation is the assumption that aid adds to the national savings, thereby increasing investment and growth and eventually also reducing poverty (Schabbel 2007, p.9). However, despite the theoretical predictions and the wide influence of Burnside and Dollar's (2000) study, the existence of a positive relationship between aid and growth has been strongly challenged. Over the years, researchers have produced a large number of studies with mixed answers to the question of whether aid has an impact on growth (e.g. Dalgaard et al. 2004; Karras 2006; Ekanayake & Chatrna 2010). Based on their meta-studies of all existing research, Doucouliagos and Paldam (2008; 2010; 2011) argue that there now is convincing evidence that aid has no effect on growth, even when conditioning on other commonly used factors (good policy and aid itself).²

Increasing the growth rate is generally also considered the principal way in which aid can decrease poverty. Economic growth is either assumed to cause a "trickle-down" effect where the benefits of growth accruing to the rich eventually also spread to the poor, or to cause a direct increase in income for everyone in society (Schabbel 2007, pp.201-203). Empirical research generally gives support to the hypothesis that growth at least to some extent benefits the poor (e.g. Dollar & Kraay 2002; Perera & Lee 2013). However, the results from Doucouliagos and Paldam's research (2008; 2010; 2011), which indicate that aid has no effect on growth, cast doubt on whether aid can actually affect poverty through this channel.

One aspect has, however, largely been overlooked. Despite a close relationship

¹ 2008 figures; defined as living on less than \$1.25 per day at 2005 purchasing power parity.

² In their last study, Doucouliagos & Paldam (2011) note a possible positive relationship between some types of aid and growth, although their small sample size makes it impossible to draw any reliable conclusions.

between growth, poverty and income inequality, relatively little research has looked at aid's effect on inequality. The lack of research in the area is especially surprising given indications that income inequality can have a negative impact on growth (e.g. Alesina & Rodrik 1994; Chambers & Krause 2010).³ Many countries are also unlikely to be able to achieve the high levels of growth that are predicted to be needed to reduce poverty, so a reduction in inequality is a necessary complement (Lensink & White 2000). Finding out whether foreign aid affects income inequality is of critical importance in these contexts.

The recent research on aid and growth has also increased the need for more investigations of the relationship between aid and inequality. The mounting evidence on aid's inability to affect growth could potentially be misleading due to the use of overall growth figures. If aid affects growth positively in sectors that benefit the poor while growth in sectors benefitting the rich is reduced, aid could have no effects on overall growth despite having the intended effects on poverty reduction. Research on inequality is therefore a necessary complement to studies on aid and growth.

Inequality can also have an effect on the development process that goes beyond the strictly economic. Research indicates that high inequality is considered unfair by a majority of people, and increases the risk for social problems and instability (Rawls 1971 in Todaro & Smith 2011, p.221; Todaro & Smith 2011, p.220). In an unstable and problem-ridden society, increased uncertainty and risk can slow development down. In its most destructive form, social instability can also cause material and institutional damage that reverse progress. A very unequal income distribution can therefore be a threat to both future development and any progress achieved. Aid's impact on inequality is therefore relevant also in this aspect.

Research on aid's effect on inequality is, in other words, necessary both due to the destructive consequences of inequality as well as its potential effect on growth and poverty. However, the available research on aid and inequality provides little insight into the nature of the relationship. The studies that have been conducted this far have found an almost equal share of positive or negative effects, or no effects at all (e.g. Cuesta et al. 2006; Chong et al. 2009; Herzer & Nunnenkamp 2012). Attempts to separate aid into different categories have been few and can therefore provide no definitive answer to whether certain types of aid affects inequality (Saidon et al. 2013; Tezanos et al. 2013). Consequently, it is still unclear whether aid has an impact on inequality. More research on the subject is therefore needed.

³ While many studies find a negative relationship, a number of studies are unable to find any clear relationship, or only find one conditional on other factors (e.g. Shin 2012; Bleaney 2004; Bjørnskov 2008; Persson & Tabellini 1994). A consensus on the effect of income inequality on growth is therefore not yet established.

This study aims to add to the existing research by investigating whether different types of foreign aid have any impact on income inequality in developing countries. The contribution is thereby twofold: first, the study adds to the scarce knowledge on aid's effect on income distribution, and second, the study complements the existing literature on the effects of different types of aid by using a statistically valid categorization of aid that has not previously been used in the field. In the study, a cross section and period fixed effects (FE) as well as a cross section random effects (RE) regression are run on an unbalanced panel of 116 countries over the years 1972-2011. The Gini coefficient is the dependent variable while aid separated into four statistically valid categories, together with a set of control variables, are used as the explanatory variables. The regression results show that a relationship to inequality exists for all four types of aid. For economic and social aid the relationship is positive, while reconstructional and residual aid exhibit a negative relationship.

In the next section (2), definitions and measures of aid and inequality are examined, and in the section following that (3), previous research on the subject will be reviewed. In section 4, the theoretical framework will be discussed, and in section 5 the model that will be used in the study is presented. Section 6 provides an overview of the data selection, followed by a discussion of the methodology in section 7. Finally, section 8 discusses the results and section 9 contains a summary of the study findings.

2. Definitions

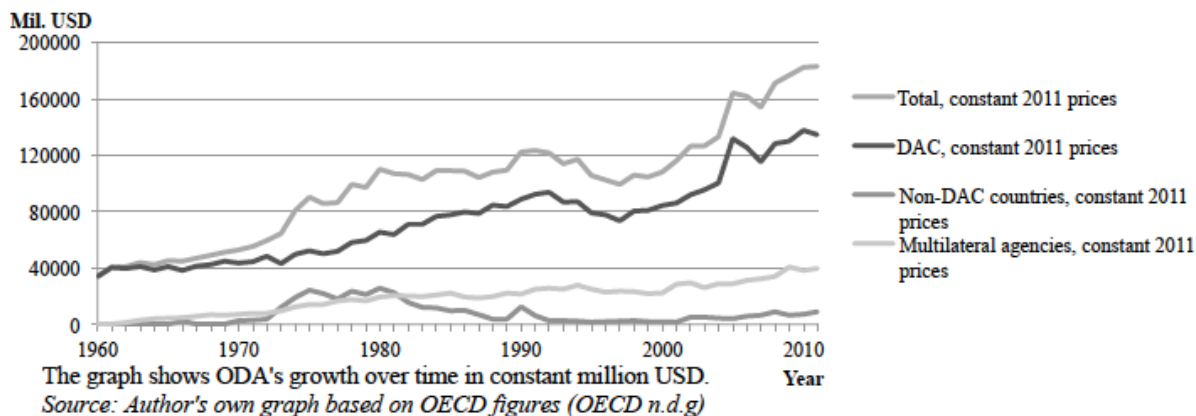
2.1 Foreign aid

In its broadest sense, foreign aid can be said to be a transfer of funds by multilateral and bilateral donors, or by private non-governmental organizations (NGO's), in an effort to promote development in poor countries (Todaro & Smith 2011, p.698). However, in official statistics focus lies on public aid so NGO transfers are usually excluded (Todaro & Smith 2011, p.698). To be defined as aid the purpose of the transfer must also not be commercial, and any loans must be concessional; in other words, interest rate and repayment period must be less burdensome than for loans offered on the regular market (Todaro & Smith 2011, p.698). As a rule, aid for military purposes is also not counted in official aid measures (Todaro & Smith 2011, p.698). For an accurate account of the level of help that developing countries receive, less obvious transfers of funds such as preferential tariffs and technical assistance costs should be counted as aid, but in reality not all of them are (Todaro & Smith 2011, p.698).

Today, around 95 percent of all aid comes from the 28 countries that are members of The Organization for Economic Co-operation and Development's (OECD's) Development Assistance Committee (DAC) (Tarp 2008; OECD n.d.d). The influence of the DAC is also evident by the widespread use of its aid measures in both research and by international organizations such as the United Nations (UN). The Official Development Assistance (ODA) measure has been produced since the 1960's and is the most widely used measure for evaluations of aid flows (OECD n.d.a). ODA encompasses both loans and grants given to the government of a developing country (Tarp 2008). In addition to having to come from a multilateral or bilateral donor and having a development objective, a transfer must consist of at least 25 percent grants to be considered ODA (OECD n.d.a). Aid can also be considered ODA only if it goes to a country listed as one of the traditional aid recipients; aid that goes to other countries, such as those in Eastern Europe, is classified as Official Aid (Tarp 2008).

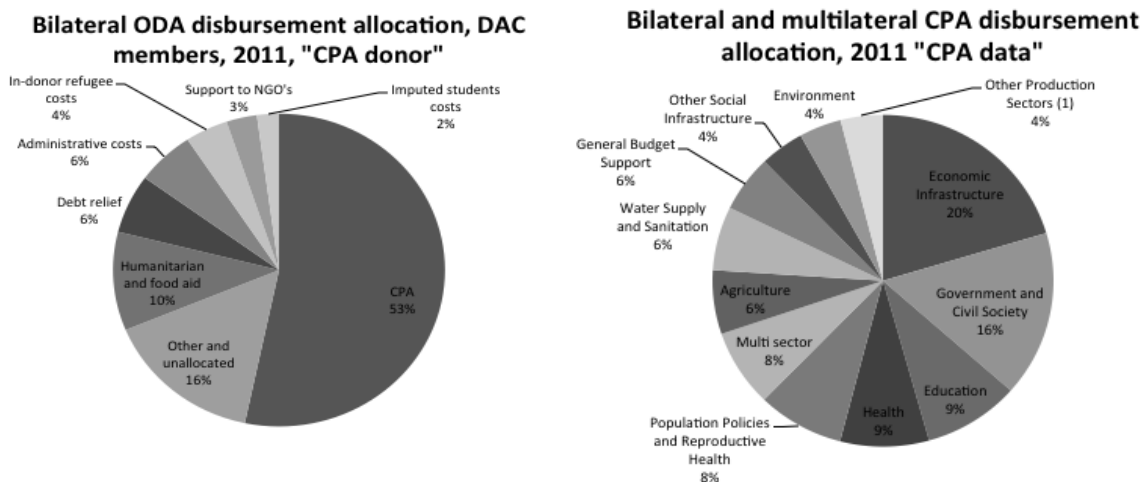
Measured in constant prices, the trend has been for total ODA to grow over the years, and after a smaller dip during the recent recession, aid is again increasing and reached its highest figure ever in 2011 (see Figure 1) (OECD n.d.f). However, the decrease in aid during the recent recession illustrates how sensitive aid is to donors' financial situation and priorities. Changes in the amount of aid that a country receives from a donor, so called aid volatility, is hypothesized to cause a number of negative effects in recipient countries (Tengstam 2013).

Figure 1. Total ODA Aid 1960-2011



In an attempt to more accurately capture the flow of aid that actually reaches the developing countries, the DAC now also produces the Country Programmable Aid (CPA) statistic (Benn et al. 2010). This measure is a subset of the ODA and excludes aid that is unpredictable (e.g. humanitarian aid) or not covered in agreements between donor and recipient (e.g. aid through other agencies), as well as aid that is used in ways that means that it does not materialize as funds in the recipient's accounts (e.g. administrative costs) (Benn et al. 2010). In contrast to ODA, CPA also does not subtract loan repayments (OECD 2008; Benn et al. 2010). Research shows that CPA provides a good estimate of the quantity of aid that reaches developing countries, which generally amounts to around half of a DAC member's gross ODA (Benn et al. 2010). The CPA also provides figures on the sectoral allocation of aid; an overview of the current allocation can be found in Figure 2.

Figure 2. Aid allocation 2011



Source: Authors own graph based on OECD data (OECD n.d.b).

(1) Includes forestry, fishing, industry, mining, construction, trade policy and tourism

Source: Authors own calculations based on OECD data (OECD n.d.c).

2.2 Inequality

From an economic perspective, inequality can be defined as the disproportionate "distribution of economic stocks or flows among economic agents" (A Dictionary of Economics 2009).

Measures of inequality among a country's population can therefore be based on a number of factors, such as wealth, land, or other assets. In recent decades, an increasing number of economists have also argued that multidimensional measures are needed to fully capture the extent of inequality (Nilsson 2007). However, although multidimensional, asset based, and other flow-based inequality measures can be informative, focus within the economic field is generally on measures of income inequality (Brandolini & Smeeding 2008).⁴

A number of methods can be used to measure income inequality. The most straightforward way to look at this type of inequality is to divide the population into quintiles (or deciles) based on each person's income, and compare the proportion of the income that goes to the different quintiles (deciles) (Todaro & Smith 2011, pp.204-205). More complex inequality measures includes the class of generalized entropy (GE) measures, which provides a greater amount of detail on the nature of inequality, such as information on to what extent an overall change in inequality is due to changes in between-groups or within-group inequality (Haughton & Khandker 2009, pp.111-112). Another such class of measures of higher complexity is Atkinson's, which makes it possible to produce inequality measurements that are sensitive to the opposition to inequality (Haughton & Khandker 2009, p.107).

The most common measure of inequality is, however, the Gini coefficient. The measure is based on the Lorenz curve, which displays a country's distribution of income during a certain time period, using cumulative income percentages on the vertical axis and cumulative population percentages on the horizontal axis (Todaro & Smith 2011, p.206-207). Consequently, the wider the space between a country's Lorenz curve and the diagonal curve tracing out complete equality, the larger the inequality in said country. The Gini coefficient is calculated by taking the ratio of the area between the two curves to the total area under the complete equality curve (Todaro & Smith 2011, p.208). The Gini coefficient's values therefore range from 0 to 1 (sometimes adjusted to 0 to 100), where 0 implies complete equality and 1 (or 100) implies complete inequality (Todaro & Smith 2011, p.208). In countries with relative equality, the Gini coefficient is found somewhere between 0.2 and 0.35, while countries with a Gini coefficient over 0.5 are considered high inequality countries

4 Since this study uses an inequality measure based on income, the rest of the text in this section will focus on this type of inequality. However, the different income inequality measures discussed in this passage can also be used to measure inequality based on other factors.

(Todaro & Smith 2011, p.208).

Although the Gini coefficient meets many of the desired properties of an inequality measure, there are also some disadvantages with the measure (Todaro & Smith 2011, p.209). Two different distributions with Lorenz curves which cross can theoretically have the same Gini coefficient, despite representing two different situations (Todaro & Smith 2011, p.210). In contrast to the GE measures, it is also not possible to disaggregate or add up Gini coefficients of different subgroups, and the coefficient does not allow for easy testing of the significance of any changes (Haughton & Khandker 2009, p.106).

Calculations of inequality measures can be based on a number of different income definitions. Definitions can differ in the types of incomes that are included, the length of the time period for which data is collected, and whether gross or net figures are used (Brandolini & Smeeding 2008). In developing countries, consumption figures are sometimes also used as a substitute for income due to the difficulty of determining incomes, especially among the poor population (Deaton 1989; Srinivasan & Park 2000; Brandolini & Smeeding 2008). Since different definitions produce distinct income figures, calculations of income inequality must be based on data using the same income definition if the measurements are to be comparable.

Measures of income inequality are also sensitive to the treatment of the income data. Income can be calculated for different reference units, such as households or individuals (Brandolini & Smeeding 2008). In addition, there are several different equivalence scales, or ways to adjust the data when calculating the income of a certain reference unit, to take into consideration the way household size and composition affect the income that goes to each individual as well as the monetary needs of that individual (Brandolini & Smeeding 2008; United Nations University World Institute for Development Economics Research n.d.). To ensure that inequality measurements can be compared, income data that have all been adjusted in the same way must be used when calculating the inequality measure.

There is abundant evidence for the need to accurately capture and study inequality. One of the negative consequences of inequality is a potential reduction of growth. Although disputed by some researchers, many studies find that income inequality has a negative impact on growth (e.g. Alesina & Rodrik 1994; Chambers & Krause 2010; Vu & Mukhopadhyaya 2011; see for example Bleaney & Nishiyama 2004; Bjørnskov 2008 for somewhat conflicting views). Several inefficiencies caused by inequality have been documented and provide a possible explanation to how growth could be affected by inequality. The observed inefficiencies include the effects of unequal asset distribution, reduced borrowing, rent seeking and decreased national savings rates.

Unequal ownership of assets such as education or land can be a consequence of income inequality, and has been shown to be inefficient (Todaro & Smith 2011, p.220). High inequality also creates inefficiencies by reducing the poorer population's possibilities to borrow money (Todaro & Smith 2011, p.220). When the poor are unable to get loans, they are also unable to invest sufficient capital in their businesses and in education for their children (Todaro & Smith 2011, p.220). The result is a lower number of growing firms that can create jobs and economic development, and a loss of productivity in future workers. Unequal asset distribution and reduced capacity for borrowing among the poor can therefore create inefficiencies that restrict economic growth.

Further inefficiencies are caused by rent seeking. In highly unequal societies, the wealthy have the ability to spend resources on maintaining their privileged situation (Todaro & Smith 2011, p.220). As a result, rent seeking is more common in such societies (Todaro & Smith 2011, p.220). From an economic point of view, rent seeking is inefficient since it causes resources to be spent on unproductive activities (Stone 2008, p.225). Consequently, rent seeking detracts resources from productive purposes and can reduce growth.

High inequality also causes inefficiencies related to reduced national savings rates (Todaro & Smith 2011, p. 220). Since the wealthy tend to place their money abroad or spend it on foreign luxury items, savings rates among the rich are in fact lower than in the mid and low income brackets (Todaro & Smith 2011, p.220). High inequality therefore reduces a country's savings, and thereby decreases the productive investments (Todaro & Smith 2011, p.220). Although today's dominating neoclassical growth models generally consider savings and investments to be related to the level of the steady state rather than the growth rate, low savings and investment rates prevent a country both from going through the growth period needed to reach a higher steady state, and from staying at this level (Burda & Wyplosz 2013, pp.64-66). Hence, high inequality can cause inefficiencies that affect a country's short-term growth rate as well as its standard of living (Burda & Wyplosz 2013, pp.64-66).

High income inequality does not only cause economic inefficiencies and potentially reduced growth; in addition to the directly economic effects, a number of social problems are associated with inequality. Empirical research shows that violent crime rates are higher in countries where inequality is high (Hsieh & Pugh 1993; Fajnzylber et al. 2002). Countries with high income inequality also suffer lower life expectancy and worse health than similar countries with less inequality, also when the effects from material deprivation are controlled for (see Wilkinson & Pickett 2006 for a review). The reductions in freedom and capabilities that result from these social problems have the potential to stifle both growth and more

general development.

High inequality also increases the risk of social instability and its potentially disastrous economic effects (Todaro & Smith 2011, p. 220). Inequality increases the political power of the wealthy, making social reforms that benefit the majority of the population, but have negative effects on the elite, more difficult to get through (Todaro & Smith 2011, p. 220). As a consequence, the risk of populism gaining influence among the poor increases (Todaro & Smith 2011, p. 220). Experiments conducted by Rawls (1971 cited in Todaro & Smith 2011, p. 221) also show that most people consider some inequality necessary to incentivize good behavior, but deem current levels of income inequality too high. Social unrest caused by rising populism or by general frustration with the level of inequality could slow down development, or in more violent and materially destructive cases, even reverse progress.

3. Literature review

Research on the relationship between aid and within-country inequality is remarkably limited. The existing studies also present surprisingly contradictory results, so a conclusion on the direction of the effect, or as to whether an effect exists at all, has not yet been obtained (see Appendix B.2. for an overview).

Out of the existing research, two studies fail to demonstrate that an effect exists. Chong et al. (2009) use the generalized method of moments (GMM) technique on data for 116 countries for the years 1971-2002 to test whether aid has an impact on income inequality but find no statistically significant effect. When taking the quality of a country's institutions into account the results do show that aid reduces inequality, but this effect fails to be robust. Also Layton and Nielson (2008) fail to find a robust relationship in their study on 82 countries over the years 1975-2005. They run ordinary least squares (OLS) and two stage least square (2SLS) regressions on panel data and find that aid has a positive effect on income inequality in many cases, but the effect is often not statistically significant and not stable to changes in the assumptions of the model.

A few studies find robust and statistically significant positive relationships between aid and inequality. Bjørnskov (2010) uses a random effects weighted least squares (WLS) technique on 88 countries over the years 1960-2000 to investigate the effect of ODA and democracy on the income distribution. The results show a positive association and potential causality between aid and inequality in democracies, but the effect is missing in non-democratic settings. Herzer and Nunnenkamp (2012) instead employ a bivariate model and panel cointegration techniques on data from 21 countries over the period 1970-1995 and find that the long-run effect of aid on income inequality is positive.

In contrast, a number of studies show that aid has a negative effect on income inequality. Cuesta et al. (2006) use an ordered probit model to investigate income inequality in 30 countries over the years 1995-1998. The result shows that aid generally reduces inequality if it is given during a longer time period, but there are regional differences in the strength of the effect. Shafiullah (2011) runs random and fixed effects regressions on a panel of 88 countries over the period 1989-2008 and finds that the growth rate of aid has a negative effect on inequality. However, when looking at a subsample of only South Asian countries, the effect is unclear. Tezanos et al. (2013) restrict their sample to Latin American and Caribbean countries. In contrast to the other studies, their research is based on growth theory and looks at the growth rate of GDP per capita of the population in the poorest decile compared to the general per capita growth rate. A generalized method of moments (GMM) is

used on panel data for 20 countries for the period 1992-2007, and the results show that aid has a proportionately bigger positive impact in the investigated decile. When separating ODA into grants and loans, the tests show that both types of aid cause inequality-reducing growth, but ODA loans have a larger effect. Saidon et al. (2013) instead separate ODA into social, economic, production, and multi-sectoral aid based on the OECD/DAC classification. The study uses the generalized method of moments (GMM) on panel data for 75 countries for the years 1995-2009. The results show that only aid to the economic sector and the multi-sector have statistically significant effects, with the former having a negative impact on inequality, while the latter has a positive impact. For aid to the social sector and the production sector, no effect on inequality is found.

With only a small number of studies and very mixed results, the question of whether aid has an impact on inequality is still unanswered. An important area to explore further is the separation of aid into different categories. As long as aggregate aid data is used, research runs the risk of capturing several conflicting effects on inequality as only one, overall effect. While such research can give valuable insights into the effects that aid of the current composition has, it does not necessarily produce results that can provide appropriate guidance for future policy decisions. Although Tezanos et al. (2013) and Saidon et al. (2013) have produced interesting work in this area, no study has yet used an aid categorization that is prepared specifically for the study of the impact of sectoral aid. Another important point is that none of the existing studies included aid that is not reported to the OECD/DAC. Research that excludes some aid flows runs the risk of overlooking important aspects of aid's impact on inequality. Using an aid categorization designed specifically for the purpose and more comprehensive aid data therefore has the potential to produce better results, so this study will employ both.

4. Theory

4.1 Inequality

Theoretical models generally predict that foreign aid increases inequality, identifying as possible reasons self-interested politicians, donor allocation and aid agency incentives, focus on economic growth and Dutch disease problems.

A common theoretical prediction is that politicians in countries receiving aid will spend the money in ways that benefit the powerful elite and the special interest groups that support them in elections (Layton & Nielson 2008, Herzer & Nunnenkamp 2012). Since aid in this model is spent on the already wealthy, inequality increases. Empiric research indicate that the problem of elites using aid for their own objectives occurs regardless of the kind of government that is in power (Boone 1996). The fact that aid is a source of government income that does not depend on the population's acceptance of the government also means that aid can increase the problem of self-interested politicians and further raise inequality (Moore 2004). With government funding separated from the population, governments are hypothesized to have less incentive to listen to what the larger, poorer part of the population want (Moore 2004). Svensson (2000) points out that aid might even create an incentive for governments to maintain the status quo since lowered poverty is likely to decrease the amount of aid the country receives.

The politics of aid donors can also cause aid to generate inequality. Since aid is not necessarily allocated based on a country's needs (Todaro & Smith 2011, p.700), aid-receiving countries might feel a need to spend resources ensuring that they are seen as an attractive recipient also in the future (Layton & Nielson 2008, Herzer & Nunnenkamp 2012). Aid might therefore be channeled into projects that aim to develop the relationship to the donor country, and which are far more likely to benefit the local elite than the poor (Layton & Nielson 2008, Herzer & Nunnenkamp 2012). Structural adjustment requirements tied to aid have in the past often also meant that recipient countries were forced to implement changes, such as cuts in social spending, that are detrimental to the poor (Herzer & Nunnenkamp 2012). Demands from taxpayers and politicians in donor countries that aid should produce noticeable improvements can also lead to increased inequality (Herzer & Nunnenkamp 2012). Pressure to be able to show results can cause aid agencies to focus on easier projects and to take less risks, meaning that projects might not reach remote areas or the poorest segments of the population (Herzer & Nunnenkamp 2012).

The strong focus on aid's effect on economic growth could also cause aid to increase

inequality. When growth is in focus, aid is likely to be invested in the most productive sectors of the economy (Layton & Nielson 2008). Although growth in these sectors should benefit workers as well as owners, the majority of the profits are likely to end up with the latter group (Layton & Nielson 2008). A strong focus on growth can thereby lead to increased income inequality.

Finally, foreign aid can also cause Dutch disease. Inflows of aid can make a country's real exchange rate appreciate, which leads to decreased competitiveness of the manufacturing sector and increasing unemployment (Bjørnskov 2010). With an increasing share of the population in unemployment or forced into subsistence agriculture or the informal sector, inequality increases (Bjørnskov 2010).

4.2 Theoretical framework

A lot of research looks at the determinants of income inequality. In this section, the theory behind the most common factors will be discussed, and the empirical research on their effects will be reviewed. The discussion aims to provide the theoretical background for the model that is developed in the next section.

4.2.1 *Economic growth*

One of the factors most commonly assumed to have an effect on income inequality is economic growth. The relationship between growth and inequality was analyzed by Kuznets (1955) in a widely influential essay. Kuznets hypothesizes that in a country experiencing economic growth, income inequality will over time trace out an inverted U-curve. The initial increase in inequality is a logical consequence of growth given that only the rich can afford to save, that rural income per capita is lower than urban, and that inequality within rural areas is lower than inequality within urban areas. Consequently, as farmers and agricultural workers move into the new, growing industries in the urban areas, income inequality increases.

The increase in inequality will eventually decline and turn into decreasing income inequality. Kuznets argues that a number of factors brought on by the economic growth will help reduce the buildup of savings among the rich and create this shift of direction, identifying as examples increased pressure on the government to reduce inequality as per capita GDP grows, technological change making old high-profit firms less profitable than newer firms, and higher relative increases in income in manufacturing and service jobs than among professionals.

Empirical research has produced an inconclusive verdict on Kuznets' inequality

hypothesis. About half of the research finds support for the existence of an inverted U-curve (e.g. Chen 2007; Bhandari et al. 2010; Mollick 2012), while the other half fail to find the expected curve (e.g. Deininger & Squire 1998; Desbordes & Verardi 2012; Huang et al. 2012).

4.2.2 Globalization

Globalization is also hypothesized to affect inequality. However, studies that use an aggregate globalization measure find very mixed results, with both the existence of an effect in different types of countries and its potential sign varying wildly between studies (e.g. Dreher and Gaston 2008; Zhou et al. 2011; Ha 2012). The inconclusive results and the multifaceted nature of globalization have prompted researchers to attempt to improve the analysis by separating the different aspects of globalization. Although a set definition of globalization does not exist, the economic aspect of globalization can be said to be about "increased openness of economies to international trade, financial flows, and direct foreign investment" (Todaro & Smith 2011 p.565). The empirical investigations of the different globalization aspects' effects on inequality have therefore centered on these factors.

In standard trade theory, increased economic integration decreases the within-country inequality in developing countries. The Heckscher-Ohlin model predicts trade based on different factor endowments, where countries specialize in producing goods for which their endowment gives a comparative advantage (Todaro & Smith, 2011, p.577). In other words, developing countries with an abundant labor supply have access to cheaper labor and specialize in labor-intense production. The increased demand for labor in these countries drives its price upwards, while the price of capital decreases (Todaro & Smith, 2011, p.580). Trade therefore gives rise to a more equal income distribution in developing countries.

The Heckscher-Ohlin model does, however, suffer from several limiting assumptions. Differences in labor productivity, variations in employment as well as in resource utilization and quality, and the effects of political economy elements in trade policy are some of the real world circumstances that the model does not take into account (Todaro & Smith, 2011, pp. 582-583). Including more than two countries or factors of production also makes the model's prediction of the effects of increased economic integration less certain (Anderson 2005).

Empirical research is also unable to deliver a consensus on the nature of the relationship between trade openness and inequality. Studies show that it is unclear whether this factor increases, decreases, or has no effect on inequality, and whether the effect differs between high- and low-income countries (e.g. Gourdon et al. 2008; Jaumotte 2013; Savvides

1998; Meschi 2009). The existing research therefore seems to support the idea that the effect of trade openness depends on a country's specific situation (Anderson 2005; Bensidoun et al. 2011).

For FDI⁵, theoretical models generally predict increased income inequality. An inflow of FDI raises the demand for skilled workers and thereby the wages going to this group, so greater wage inequality should be expected (Tsai 1995). FDI is also likely to increase the use of physical capital in previously labor-intensive production, thereby creating unemployment among unskilled workers and even further differences in earnings (Tsai 1995). However, some models predict the opposite results. FDI is in this view not different from other capital, and will therefore contribute to growth that can benefit everyone in society (Tsai 1995). What is important for lowering inequality is, according to this view, not the FDI itself but other measures that ensure that the growth FDI generates is made to benefit also the poor (Tsai 1995). Empirical research on FDI and inequality largely supports the models that predict greater inequality (e.g. Jaumotte 2013; Choi 2006; or Clark et al. 2011 for a review; for opposing results see for example Franco 2013; Sylwester 2005).

4.2.3 Government intervention

Government policies can have substantial effects on income inequality. Such policies can be divided into four main areas (Todaro & Smith 2011, p.242). The first area of policies concerns the returns to factors of production (Todaro & Smith 2011, p.242). If unions or other actors drive up (down) workers' wages (physical capital prices) to a level that does not correspond to their real market value, government intervention can be needed to bring prices back to their optimal level to ensure that labor is not underutilized (Todaro & Smith 2011, pp.242-243). The resulting decreases in unemployment should cause reductions in income inequality (Todaro & Smith 2011, p.242). However, some economists hold an opposing view and argue that keeping wages higher than their market value through the use of minimum wages increases the bargaining position of workers in the informal and low-skill sectors (Todaro & Smith 2011, p.243). Minimum wages would therefore be beneficial to the poorest workers, and would help reduce income inequality (Todaro & Smith 2011, p.243).

Asset redistribution is the second area in which government intervention can be used to affect inequality. Countries with high income inequality are often also characterized by high inequality in assets, so correctly implemented policies that reduce this imbalance can be hugely effective in reducing income inequality (Todaro & Smith 2011, p.244).

⁵ Although other financial flows could affect inequality, the discussion here will be limited to FDI

Governments can also use tax policies to reduce net income inequality. However, a common phenomenon is that what looks like a progressive system is in fact regressive when taking into account the full amount of taxes that the low and middle income group pay on their wages and consumption (Todaro & Smith 2011, p.245). Wealthy people receive more of their income from financial or physical assets for which they usually pay low or no tax, and are charged relatively little indirect taxes since they consume only a small proportion of their income (Todaro & Smith 2011, pp.245-246).

Finally, income inequality can be reduced by direct spending or transfers to the poor, or through indirect channels such as job creation in the public sector (Todaro & Smith 2011, p.242). Such policies do not only reduce inequality through the actual transfer of money; in addition, the existence of a safety net can also contribute to less inequality by offering people a basic insurance if their business attempts fail, thereby increasing the likelihood that poor people dare take on the risk associated with investing in small business endeavors that could bring them out of poverty (Todaro & Smith 2011 p 246).

Empirical research seems to find support for the idea that the minimum wage reduces inequality (e.g. Teulings 2003; Fairris et al. 2008; Silveira Neto & Azzoni 2011), although some studies demonstrate that under certain conditions the effect can be low or even positive (e.g. Neumark et al. 2006; Wooden et al. 2007; Angel-Urdinola 2008). Research on asset redistribution such as microfinance is scarce, but the available studies find reductions in poverty and income inequality (e.g. Mahjabeen 2008). Empirical research also supports the idea that taxes and transfers reduce income inequality when implemented in an appropriate way (e.g. Baer & Fialho Galvão Jr. 2008; Forteza & Rossi 2009; Goñi et al. 2011).⁶

4.2.4 Inflation

Inflation is often brought up as a factor that can affect inequality. Both statistics showing higher relative holdings of currency among low-income people as well as evidence of inflation being perceived as a higher threat in this group support the hypothesis that inflation has a greater negative impact on the poor (Albanesi 2007). Empirical research seems to confirm that a positive relationship between income inequality and inflation exists (e.g. Beetsma & van der Ploeg 1996; Al-Mahrubi 2000)⁷. However, in most theoretical models it is income inequality that causes inflation through increases in a variety of redistributive

⁶ For human capital see section 4.2.7

⁷ For democracies a consensus seems to have been established; for non-democratic settings some studies with conflicting results have been published (e.g. Desai et al. 2005).

policies (e.g. Beetsma & van der Ploeg 1996; Dolmas et al. 2000; Albanesi 2007). Although many studies do not determine the direction of the causation there seems to exist little evidence that contradicts the results of these models. Examinations of whether inflation has any effect on income inequality also find no significant effect (Jäntti & Jenkins 2010).

4.2.5 Population size and composition

Population growth is hypothesized to increase income inequality in developing countries. The microeconomic household theory of fertility provides a possible explanation of the process. The theory uses neoclassical consumer behavior assumptions and utility optimization principles as an explanation of how households determine the number of children to have (Todaro & Smith 2011 pp.285-286). Children are seen as a consumption good (or investment), whose demand is determined by the cost of having a child, household income, and demand for other goods (Todaro & Smith, 2011, pp.286-288).

In developing countries, the demand for children can be high among the poor. In very poor households, the parents' need for additional income as well as financial security at old age can increase the desired number of children (Todaro & Smith, 2011, p.288). In addition, the child mortality rate is often higher in regions where poor people live so the number of children a household decides to have can be influenced upwards by this (Todaro & Smith, 2011, p.288). The cost of having children, determined by the mother's forgone wages, is also relatively low in poor households where women often have little education and therefore low income possibilities (Todaro & Smith, 2011, p. 289). Empirical research on the consequences of lowered mortality rates and increased educational opportunities for women show declines in fertility rates, thereby lending support to the prediction that the demand and the costs of children affect birth rates (Angeles 2010; Buyinza & Hisali 2013; Canning et al. 2013; Malik 2011).

Consequently, based on the microeconomic household theory of fertility, higher than average fertility rates can be anticipated among poor people in developing countries. Population growth in such countries is therefore expected to consist of a disproportionate increase of people in the poorest households, which leads to higher income inequality.

Although economic growth can balance out the effect, high population growth can increase the demands on an often fixed government budget, thereby reducing the spending per capita (Todaro & Smith, 2011, p.296). Such a reduction affects the poor the most, by restricting access to health care, education, or other services that help this group increase the possibilities of raising their income (Todaro & Smith, 2011, p.296). Population growth could

therefore worsen income inequality also in this way.

Empirical research generally supports the hypothesis that population growth causes greater income inequality (e.g. Gupta & Singh 1984; Ram 1984; Nielsen & Alderson 1995).

4.2.6 Democracy

The intuitive idea that democracy reduces inequality is popular in the literature (Chong 2004). Models that come to this conclusion are often based on mechanisms related to the median voter theorem. According to this theorem, politicians need to pay extra attention to the wishes of the median voter since meeting the desires of this voter is the key to success in future elections (Dictionary of the Social Sciences 2012). In countries with high income inequality the median voter will be relatively poor and redistributive measures will be favored (Milanovic 2000). Consequently, the political influence of the median voter that comes with democracy reduces inequality.

Some researchers question whether the relationship between democracy and inequality is as straightforward as the median voter theorem suggests. Beitz (1982 cited in Chong 2004) argues that inequality is lower in autocracies than in democracies, since the latter system is more easily influenced by pressure from wealthier groups. A number of researchers also argue that what can be called a political Kuznets curve can exist. In the version of Acemoglu and Robinson (2002), increased inequality caused by industrialization can force the political elite to act to prevent social unrest, thereby bringing on democratization. In such a situation, inequality increases during the industrializing phase but turns downwards as democracy is implemented, tracing out an upside-down U as in Kuznets' model.⁸

The empirical research reflects the mixed predictions of the models. Some studies find no effect (e.g. Timmons 2010), while others find that democracy causes a reduction in inequality (e.g. Reuveny & Li 2003; Huber et al. 2006; Pillai 2011). Support for the political Kuznets curve, as well as a possible positive relationship, is also found in a couple of studies (Chong 2004; Dreher & Gaston 2008).

4.2.7 Human capital

Human capital refers to factors that can increase the productivity of a person, such as education and good health (Todaro & Smith 2011 p.365). Such factors are often interlinked; for example, improved health enables an individual to get more out of their education, while a

⁸ Acemoglu and Robinson see this pattern as only one of three possible outcomes; low initial inequality could instead cause development without increasing inequality or increasing inequality without political reforms.

better education renders increased knowledge about how to stay healthy (Todaro & Smith 2011 p.361). That an increase in human capital decreases inequality seems intuitive, but formal models of human capital expansion predict more ambiguous results.⁹

Ram (1989) argues that the early literature on the subject can be separated into three different strands: the human capital framework, the dualistic-development paradigm, and the job-competition framework. A basic version of the human capital framework was developed by Schultz in 1963 (cited in Ram 1989). Schultz argues that inequality in income from physical capital is larger than the inequality in income from human capital. Furthermore, human capital is assumed to increase faster than physical capital. His model therefore predicts that as human capital increases, income inequality decreases. As Ram (1989) points out, this basic form of the model does not take into account the possibility that educational expansion could increase educational inequality. Ram notes that this is often the case in the least developed countries, at least until a higher level of average education is reached. He therefore argues that the effects of increased education are unclear; if educational inequality decreases as average education rises, the model predicts reduced income inequality, while if educational inequality increases, income inequality will increase too.

The second strand of the literature, the dualistic-development paradigm, also predicts conflicting results. Knight and Sabot (1983) argue that the effect of increasing education depends on relative wage levels, the extent of relative wage variation, and the relative size of the educated population. As the expansion of education increases the size of the population with an education and higher income, income inequality rises. At the same time, the increasing supply of educated workers reduces the wages this group is paid, which leads to lower inequality between the educated and less educated groups in the population. The overall effect of educational expansion on income inequality is therefore unclear also in this model.

The job seeker model of Thurow (1975 cited in Ram 1989) provides a less ambiguous prediction of the outcome of educational expansion. In this model, increased access to education has no effect on income distribution if it is not accompanied by more job opportunities. In a situation where the number of jobs stays constant, the educated workers will simply replace the uneducated workers, leaving income inequality unchanged.

In recent years increased attention has been paid to how the educational system can

⁹ The following discussion will focus on education, since this factor is frequently used in studies of income inequality. An alternative approach employed by many studies is to use an aggregate human capital measurement. Special focus on health effects seems to be rare, so a detailed discussion of this factor is not provided.

restrict the poor's access to quality education, and thereby can help to maintain or even increase inequality (Todaro and Smith 2011 p. 385). This argument is discussed in detail in Gruber and Kosack's (2013) study of the effects of increasing primary enrollment. They demonstrate that in developing countries, rising primary enrollment rates increases inequality in the following decade. Gruber and Kosack find the explanation in what they call the tertiary tilt, or the emphasis on investment in tertiary rather than primary education - a common phenomenon in developing countries. They argue that a tertiary tilt reduces the returns of primary education in several ways. Without adequate focus on enabling students to continue into secondary and tertiary education, the result of rising enrollment rates is an increasing supply of primary educated workers that drives wages down in this group. In addition, governments focused on tertiary education are unlikely to be able to increase spending in primary education when the number of pupils increases, so a decrease in the quality of education is likely. Consequently, even new students can be worse off if they are sacrificing time learning a trade for low-quality schooling.

The frequent use of tuition fees at the secondary level further restricts the poor's access to good education (Todaro and Smith 2011 p. 385). The fact that many governments fully fund university education, where most students come from wealthier homes, further helps to increase future income inequality (Todaro & Smith 2011 p. 385).

Although many theoretical frameworks predict increased inequality due to the educational system and its expansion, empirical research on the subject finds more positive results. While some contradicting research exists, the majority of the studies find a negative relationship between educational expansion and income inequality (e.g. Park 1996; Li et al. 1998; Sylwester 2002).

4.2.8 Corruption

Institutional quality and corruption are also factors that can affect income inequality. According to Jain (2001), corruption can be defined as "the power of public office...used for personal gain in a manner that contravenes the rules of the game". Institutional quality, on the other hand, is a broader concept focused on the standard of a state's institutions, which encompassed corruption. Both institutional quality and corruption are generally hypothesized to increase income inequality.

There are several channels through which corruption can increase income inequality. Corruption can cause a climate of uncertainty that is likely to reduce investments among the poor and middle-income earners (Gupta 2002). While the wealthy often have political power

or connections that help them avoid a great part of the uncertainty, poorer people that lack such connections will face higher risks and risk premiums on their investments (Gupta 2002).

Tax evasion or exemptions can also lead to a reduction in the resources available for social programs (Andres & Ramlogan-Dobson 2011). This hypothesis is supported by empirical research that demonstrates that corruption reduces government spending on education (Mauro 1998). Since access to tax experts and ways to avoid paying taxes are more readily available to the wealthy, the consequence of this type of corruption can also be a heavier tax burden on the less wealthy population, which in effect makes the tax system progressive (Andres & Ramlogan-Dobson 2011).

Corruption can also divert government spending into areas that benefit the wealthy population, or into areas where bribes are easier extracted (Gupta et al. 2002). In addition, corruption can negatively affect the quality of government services and lead to unnecessary expenditures if contracts are awarded based on connections rather than based on efficiency and skills (Rose-Ackerman 1996).

Empirical research shows somewhat mixed results but generally supports the notion that corruption increases income inequality (e.g. Gupta et al. 2002; Gyimah-Brempong & Munoz de Camacho 2006). The exception is research on Latin America, where a negative relationship between corruption and income inequality seems to exist (e.g. Dobson & Ramlogan-Dobson 2010; Andres & Ramlogan-Dobson 2011). A few researchers also find evidence indicating that the inequality that corruption causes could itself lead to more corruption, leading to a vicious circle of increasing inequality and corruption (Jong-Sung & Khagram 2005).

4.2.9 Economic dualism

In a development context, economic dualism is a concept relating to the sectoral division of an economy into a traditional and a modern part (A Dictionary of Sociology)¹⁰. In one strand of the literature it is strongly connected to the process of increasing income inequality resulting from the shift of workers into the modern sector and the wage differential between the two sectors (Nielsen & Alderson 1995), as first discussed by Kuznets (1955). Measures of economic dualism based on this view, especially the percentage of the population employed in agriculture, are often included in analyses of the determinants of income inequality. The

¹⁰ Generally, the traditional sector is equal to the country's agricultural sector while the modern sector refers to industrial production.

results are mixed, and negative but rarely significant relationships between agricultural employment and inequality are common (Layton & Nielson 2008; Shafiullah 2011), although a positive relationship has also been observed (Tsai 1995).

The appropriateness of including these variables is questioned by researchers such as Bourguignon and Morrisson (1998). Bourguignon and Morrisson argue that the rural-urban wage differential and the proportion of labor in the two sectors are endogenous, and consequently not suitable as explanatory variables. Instead, they develop a model focused on comparative advantage of agricultural production where the relative endowment of land suitable for agriculture, the distribution of that land, and the relative labor productivity (the ratio of agriculture to modern sector productivity) are important determinants of inequality.

Bourguignon and Morrisson base their model on a general equilibrium framework for a developing country open for trade, where all income is distributed to the production factors. In such a situation, total income and its distribution is determined by the country's factor endowment as well as the ownership distribution of the production factors. Sectoral allocation of workers and the rural-urban wage differential, which is caused by differences in skill or production factor ownership between the two areas, must then be determined by the general equilibrium and its determinants. Consequently, relative endowment of land suitable for agriculture, and its distribution, are the determinants of income differences.

Bourguignon and Morrisson then extend the model to account for dualistic labor markets with artificially high wages in the modern sector, which are generally assumed common in developing countries. In the full model, income inequality therefore depends on the relative endowment of agricultural land and its distribution, as well as a measure of the depth of the dualism, which Bourguignon and Morrisson demonstrate can be proxied by relative labor productivity in agriculture. Since the relative labor productivity does not show a strong correlation with the rural-urban income differential, the model avoids the use of endogenous factors as explanatory variables while still taking into account the dualistic nature of many developing economies.

In accordance with the predictions, Bourguignon and Morrisson's empirical research shows that agricultural land per capita, the share of such land cultivated by small or medium sized farmers, and relative labor productivity all have a negative effect on income inequality. The results are not only strongly significant, but also robust to changes in the model.

5. Model

In this study a model based largely on the work of Bjørnskov (2010) is used. However, the study differs from Bjørnskov's in that the primary interest is not the interaction of democracy and aid, and their impact on inequality, but how different types of aid affect inequality. Consequently, some modifications of the model are needed. Each statistically valid aid category will be added as an explanatory variable, and democracy will be considered a normal control variable. Also, in contrast to Bjørnskov (2010), the dependent variable used in the study is the Gini coefficient, and some additional changes of control variables are also done.

The study uses panel data, so the general regression model has the format:

$$Gini_{it} = \beta_1 + \beta_2 AidV_{it} + \beta_3 X_{it} + u_{it} \quad \text{for } i=1, \dots, N \text{ and } t=1, \dots, T, \quad (1)$$

where $Gini_{it}$ is the Gini coefficient, β_1 is the basic intercept, $AidV_{it}$ is the set of aid variables, X_{it} is a set of control variables and u_{it} is the error term, which might include time and individual-specific effects. The subset it indicates that each term is for a country (i) in a certain year (t).

The set of aid variables contains both current and lagged variables. Since aid is divided into four categories, four variables capturing the amount of aid received in the current time period in each of the aid categories are included in the set. These variables capture aid's short-term effect on inequality. In addition, the effect of lagged variables from each aid category is tested. If aid is invested in projects that aim to produce benefits in the longer run, it could take several years for the effect of aid to be noticeable. The inclusion of lagged aid variables makes it possible to capture such long-term effects. Taking both current and lagged aid variables into account, the full aid variable set has the following format:

$$\begin{aligned} AidV_{it} = & (\delta_1 Aid1_{it} + \delta_2 Aid2_{it} + \dots + \delta_N Aid4_{it}) + (\delta_{1,it-1} Aid1_{it-1} + \delta_{2,it-1} Aid2_{it-1} + \dots \\ & + \delta_{N,it-1} Aid4_{it-1}) + \dots + (\delta_{1,it-n} Aid1_{it-n} + \delta_{2,it-n} Aid2_{it-n} + \dots + \delta_{N,it-n} Aid4_{it-n}) \end{aligned} \quad (2)$$

where δ is a certain aid category's effect on inequality and n is the number of lags.

The set of control variables includes a number of the factors described as determinants of income inequality in the previous theoretical discussion. By incorporating these factors into the model as explanatory variables, their effects can be separated from effects caused by foreign aid. Variables for FDI, population growth, and the dependency ratio¹¹ are therefore included in the complete model. The coefficient signs of these variables should be positive.

Trade openness, the proportion of the population living in rural areas, and the

¹¹ The dependency ratio, or the number of people in the population not of working age divided by the number of people who are of working age, is somewhat related to population growth but can potentially provide further insights.

investment price level are also control variables in the complete model. For trade openness, both theory and empiric investigations provide mixed answers on the nature of the effect, so the expected sign is unclear. The variable measuring the proportion of the population living in rural areas is included based on Bjørnskov's (2010) arguments that consumption in such areas is underestimated due to the difficulties of counting non-traded goods. The anticipated sign of the variable is therefore positive.

Bjørnskov (2010) also suggests that economic dualism can be captured by the investment price level. The argument is based on standard economic theory which dictates that firms, in their strive to maximize profit, try to lower the cost of production. If relative capital prices are low, firms will attempt to replace the labor used in the production process with capital whenever possible (Stone, 2008, p. 289). Rising demand for capital drives the price of this factor upwards, thereby increasing its return and the inequality between workers and capital owners. Hence, the expected sign of the variable is negative. Bjørnskov argues that using the investment price level is a better option in developing countries where data on endowments or sectoral composition often is wanting and of varying quality. This study follows his recommendation on this point.

Variables for a second type of inequality determining factors are also included in the complete model. This type of variables differ from the previously discussed control variables in that the effect of foreign aid might work through them, so that the variables' inclusion in the model makes aid's actual effect on inequality difficult to observe. Government intervention, in this study proxied by government consumption, is one of the most prominent of these factors. If aid affects inequality by increasing government intervention in areas that impact inequality, the inclusion of a variable that captures the effects of government intervention will render the coefficient of the aid variable insignificant. However, the theoretical and empirical discussions suggest that government intervention might also independently affect inequality, so the factor is added to the complete model. The coefficient for government intervention is expected to be negative.

In a similar way, GDP might capture the effects of economic aid and render this variable insignificant in the regressions. However, since GDP by itself should be an important determinant of inequality, it must also be left in the model. Based on theoretical considerations, GDP is converted into the natural logarithm of GDP per capita. Also the square of the logarithmized GDP is included in the model. The logarithm is used to account for the fact that the effects of increases in GDP are likely to decline as GDP grows while the squared term is included due to the expected inverted U-shape of the Kuznets curve; this term

solves the problem of nonlinearity (Bourguignon & Morrison 1998; Bjørnskov 2010). Consequently, GDP is expected to have a positive sign while its square should have a negative sign.

Democracy is the only other factor used in this study that could potentially belong to the same type of factors as government intervention and GDP. Foreign aid has often got a democracy enhancing purpose (see for example USAID 2014; Utrikesdepartementet 2014), and the theoretical and empirical discussion in the previous section showed that democracy generally has an effect on inequality, although the sign of the effect varies. The hypothesis that aid could work through democracy is partly supported by research that indicates that aid has either a negative effect, or no effect at all, on democracy (see the meta-study by Askarov & Doucouliagos, 2013). The inclusion of democracy in the model could therefore affect the significance of the aid variables.

Three frequently used factors in research on aid and inequality will not be included in the model. Since education is largely funded by government spending, its effects on inequality should be captured by the government intervention variable. A separate variable for educational attainment is therefore not included. Also inflation will be excluded, due to the theoretical and empirical indications that inflation is determined by, rather than being a determinant of, income inequality. Due to a combination of low availability of data and a need to keep the number of variables in the model as few as possible, corruption is also not used as a control variable in the study.

6. Data

6.1 Income inequality data

The Gini coefficient variable is from The Standardized World Income Inequality Database (SWIID), Version 4.0 (Solt 2013a). SWIID is a standardization of income inequality data from several extensive data sets¹², with the Luxembourg Income Study (LIS) used as the baseline (Solt 2009). Consequently, the main advantage of the SWIID is that it makes inequality comparable over longer time and across more countries than with other datasets, while still incorporating as much information as possible from the highly rated LIS study (Solt 2009).

The fact that the SWIID estimates missing data, and therefore partly is based on estimations, can be seen as a weakness of the data set. However, the calculations of the missing data employs several techniques, such as an emphasis on proximate observations and Monte Carlo simulations, to avoid problems associated with less elaborate estimation methods (Solt 2009). The negative effects of estimating data should therefore be minimized and outweighed by the advantages of a more comprehensive dataset. The suitability of the SWIID is further demonstrated by its generally low standard errors, as well as the fact that it shows a better correlation to life expectancy and child mortality than other data (Solt 2009). In the data, gross and net incomes are also more correlated in developing countries than in developed, which is consistent with expectations since redistributive policies are less common in the former countries (Solt 2009).

The SWIID data set uses a Gini measure that ranges from 0 to 100, and the coefficient is available based on gross and net figures. Since aid goes through the government and could potentially be used for direct transfers, this study uses the net Gini coefficient.

6.2 Foreign aid data

Most research on aid uses data from the World Bank and OECD/DAC. In this study a different approach is taken, and the data on aid flows comes from AidData, a collaboration between the College of William & Mary, Brigham Young University, and Development Gateway (Tierney et al. 2011). The advantage of this data set is that it takes a broader view of

¹² The sources for the income inequality data includes the United Nations University's World Income Inequality Database version 2.0c, the OECD's Income Distribution Database, CEDLAS and the World Bank's Socio-Economic Database for Latin America and the Caribbean, Eurostat, the World Bank's PovcalNet, the UN's Economic Commission for Latin America and the Caribbean, the World Top Incomes Database and national statistical offices (Solt 2013b).

aid than DAC's ODA data. AidData includes ODA, but also incorporates aid from other donors, collected through annual reports, project web pages or direct requests (Tierney et al. 2011). Aid from DAC members that falls outside of the ODA definition, as well as past aid flows removed from DAC's data since the recipient no longer is considered a developing country, are also included in AidData's data sets (Tierney et al. 2011; AidData n.d.). The data set also contains purpose codes for all aid posts (Tierney et al. 2011). The classification follows OECD's purpose code system, but includes a number of additional codes and also attempts to capture information on the activity level (Tierney et al. 2011).

Although AidData provides more comprehensive data on aid, the data set is far from complete. A recurrent problem is the inability of some donors to provide information for more than a few data fields (Tierney et al. 2011). The problem of incomplete data is especially persistent in earlier years since donors that only recently started to report their aid flows to AidData often are unable to provide data for the years preceding their first report (Tierney et al. 2011).

This study uses disbursement figures in constant 2009 US dollars from version 2.1 of the AidData Research Release. All aid going to regional or unspecified recipients were removed from the file. In addition, since AidData reports aid figures on a project level, all project aid for a country in a certain year has been added together. For years in which a country had an aid value of zero registered, a value of zero rather than null (no data) was recorded. The data was then separated into categories based on a classification developed by Bjørnskov (2013) (see Appendix B.3.). Bjørnskov (2013) argues that principal factor analysis can be used to separate aid into statistically valid categories that will help avoid problems of multicollinearity. His analysis, based on the 24 purpose codes in the 1970-2005 data, finds four such categories: economic aid, social aid, reconstruction aid, and a smaller residual group. Consequently, separating aid into these four categories will yield better estimates of the effects of different types of aid than can be achieved with an arbitrary classification where correlations between aid categories are likely to occur. A correlation table over the four categories using the data of this study shows that the highest correlation, between social and reconstructional aid, is still rather high at 65%. However, the rest of the categories all have correlations below 45%, with the majority being around 30%.

Finally, the aid data was converted into percentage of GDP, in accordance with standard practice in the field. Although the effect of aid could possibly decline as aid as a proportion of GDP increases, logarithmizing of the aid variables was avoided to prevent issues due to the many values of zero that these variables contain.

6.3 Control variables data

Data for the control variables come from the Penn World Tables (PWT), the World Bank's World Development Index (WDI) and the Polity IV project. Details on the variables used and their modifications can be found in Table 1.

6.4 Data preparation

The raw data file contains 32 countries that are classified as high-income countries by the World Bank (World Bank n.d.c). The way aid is used in such countries is likely to differ from its use in developing countries, so the focus of the study is limited to the latter type of

Table 1. Regression variables (before detrending)

Variable	Name	Source	Definition	Format
Gini coefficient	gini	SWIID	Net equivalized household income	1 to 100
Aid economic	aidEc	AidData	Aid for economic purposes, as classified by AidData purpose codes. (1)	Percent of GDP
Aid social	aidSoc	AidData	Aid for social purposes, as classified by AidData purpose codes (1)	Percent of GDP
Aid reconstruction	aidRec	AidData	Aid for reconstruction purposes, as classified by AidData purpose codes (1)	Percent of GDP
Aid residual	aidRes	AidData	Residual aid, as classified by AidData purpose codes (1)	Percent of GDP
Log GDP per capita; log GDP per capita squared	GDP; GDPsq	PWT	From RGDPA, a variable for real GDP in constant 2005 USD (in mil.). RGDPA is based on a 2005 benchmark study and calculated for the rest of the years from national account growth rates (Feenstra et al. 2013a). "GDP" and "GDPsq" are calculated as RGDPA divided by the population size variable, logarithmized (and squared). In (real GDP / population size); $[\ln(\text{real GDP} / \text{population size})]^2$	Log of GDP; log of squared GDP
Trade openness	trade	PWT	Measured as trade as a share of GDP; the share of goods import variable plus the share of goods exports variable: (<i>share of imports + share of exports</i>). Multiplied by 100 to convert into percentages.	Percent of GDP
Government intervention	gov	PWT	Government consumption as a share of output-based GDP in purchasing power parity (PPP) rates, multiplied by 100 to convert into percentages.	Percent of GDP
Population growth*	pop	PWT	Yearly rate of change over the trend, calculated based on the population size variable. <i>Note: variable is detrended, see section 7.2 for details</i>	Percent
Investment price level	inv	PWT	Measured as Price level of the capital stock variable, with the US 2005 figure as base year. Multiplied by 100 to convert into percentages.	Percent
FDI	fdi	WDI	Net inflows of capital purchasing 10% or more of stock in a firm in the country, divided by GDP. (2)	Percent of GDP
Population living in rural areas	rur	WDI	Estimates by the WB's staff based on the UN's World Urbanization Prospects; definitions of what constitutes rural population from national statistical offices. (3)	Percent of total population
Dependency ratio	dep	WDI	Dependent population (aged under 15 or over 64) divided by working age population (aged 15-64). Estimates by the WB's staff based on data from the UN, national statistics offices, household surveys and ICF International (4)	Percent of working age population
Democracy	dem	Polity IV	Democ variable. Measured as a composite of "competitiveness of political participation...the openness and competitiveness of executive recruitment...and constraints on the chief executive", on the 31st of December of the year in question. (5) **	0 to 10 (higher values indicate higher democracy)

The table lists all variables used in the regression analysis together with their source and definition, before detrending (see section 7.2).

Sources: The Standardized World Income Inequality Database (SWIID) by Solt (2013a); AidData by Tierny et al. (2011); Penn World Tables (PWT) by Feenstra et al. (2013b); the World Bank's World Development Indicators (WDI), see below; Polity IV by Marshall et al. (2013).

Notes: (1) Based on Bjørnskov's (2013) classification. (2) The World Bank n.d.c. (3) The World Bank n.d.d. (4) The World Bank n.d.b. (5) Marshall et al. 2013.

*Detrended variable **The variable was cleaned from values representing political interruption (e.g. foreign occupation), state collapse or transition periods before a new regime, in accordance with methods already in use for other variables in the dataset. Interruption is coded as a missing value, state collapse as a zero and transition period scores are approximated using linear interpolation (as per Marshall et al. 2013).

countries. All 14 countries that have been classified as high income since 1987, or since they were first classified, are therefore removed from the file (World Bank n.d.a). To avoid excluding any countries that successfully used their aid for development purposes, all countries that went from a lower classification to becoming a high-income country during the period 1987-2011 are included in the analysis. Twelve countries for which the World Bank had no income classification were also removed from the file.¹³

Due to the scarcity of data from developing countries, all variables used in the study are averaged over four year periods (as per Bjørnskov 2010). Averaging the variables also helps to avoid having the results affected by business cycles, measurements errors or noise (Bjørnskov 2010). Despite this adjustment, data for the years 1960-1971 is still very scarce, so these years are not included in the analysis. All countries with Gini coefficient for only two or fewer years are also excluded. After removing such countries, 126 countries for the time period 1972-2011 are left in the data. Two of these countries have aid data for less than two of the time periods in which they have a Gini coefficient and are therefore removed too. Another 8 countries have no GDP information, which makes it impossible to convert their aid into a percentage so these countries are also removed, leaving a total of 116 countries for 1972-2011 in the data.

Since many countries have neither Gini nor aid figures for every year, the panel is unbalanced. Although an unbalanced panel can cause some methodological complications, the major problem with such panels – a bias in which data is missing - should not be a serious problem in this study. In general, aid is allocated to all developing countries and should not exclude any particular kind of country. A potential relationship between missing Gini coefficient data and a certain type of country, such as countries with governments paying little attention to social problems or with lower income, could exist but are likely have a small, if any, effect.

Although most of the control variables are almost universally filled for the panel years, FDI data is only available for around half to two thirds of the countries in the first three time periods. Consequently, when FDI is added to the model, the number of observations included in the regression for the first periods will drop substantially.

¹³ Of these, all but Taiwan are also missing too much data on aid disbursements and Gini coefficients to be included in the study. Taiwan received aid only during three years, and is therefore excluded as well.

7. Method

7.1 Panel analysis

This study uses panel data analysis to investigate the relationship between foreign aid and inequality. Panel analysis provides several advantages, in particular when working with a large number of countries. With this type of analysis the effects of omitted variables can be captured, making it possible to avoid biased or inefficient estimates due to unobserved heterogeneity between countries (Dougherty 2011, p.514). For research on developing countries, where differences in country characteristics can be large, this feature is especially useful. In a similar manner, panel data also provides the possibility to capture time-specific effects, to ensure that differences over time do not cause biased or inefficient estimates.

The combination of time and cross country data also means that panel data has a high number of observations (Dougherty 2011, p.515), thereby ensuring higher degrees of freedom for analyses. As a result, the probability distribution of the random variable becomes closer to a normal distribution, so more precise estimates are obtained (Dougherty 2011, p.48). In addition, panel data analysis makes it possible to gain information on the dynamics of the studied variables and the characteristics of a country that cannot be gained with only time or cross country data (Dougherty 2011, p.514-515). Consequently, although the use of a panel can complicate the regression analysis in some aspects, the method also provides several advantages that will be beneficial to the study.

7.2 Data examination

Before the actual regression analysis takes place, careful examination of the data is necessary. Linear regression relies on a number of assumptions about the regression model and its components, and violations of these assumptions can cause biased, inefficient and inconsistent estimates, as well as invalid standard errors (Dougherty 2011, e.g. pp.306-310; 331). If the data is found to contradict any of the assumptions it indicates that the actual variable included in the regression model also violates this assumption. An awareness of such violations makes it possible to adapt the variables or the model, and provides greater understanding of the potential problems with the regression estimates in cases where an appropriate adaptation is impossible. A thorough analysis of the data to identify any incompatibilities with the assumptions is therefore crucial.

Multicollinearity is a sign of violations of the linear regression assumption that the

independent variables are not exactly linear (Dougherty 2011, p.300). An indication of problematic levels of multicollinearity in a regression are high coefficients of determination (R^2) combined with insignificant t-statistics (Dougherty 2011, p.105, p.179). Correlations between independent variables can be used to anticipate possible multicollinearity in simpler models, but in regressions with three or more independent variables multicollinearity can be a problem even when no such correlation exists (Dougherty 2011, p.165, 168). The main method employed in this study to avoid incorrect conclusions due to multicollinearity is therefore examinations of the regression results.

For regressions on time series data, special care needs to be taken to meet the assumption that all data is stationary (Dougherty 2011, p.463). Signs of non-stationarity are generally visible on a simple graph of a variable over time. However, two types of non-stationarity exists so for this study a panel unit root test of the Fisher-type, using an augmented Dickey-Fuller (ADF) test, was used to determine whether stationarity can be achieved through differencing or through a removal of the trend (Dougherty 2011, pp.473-474, 489). To determine the type of ADF test needed, graphs of each variable over time were examined for time trends (as per Dougherty 2011, pp.490-491). On theoretical grounds, several variables can be expected to be non-stationary. As Table 2 displays, the graphs and

Table 2. Fisher-Type augmented Dickey Fuller unit root test for panel data

Variable	Theoretical expectation	Graphical representation	ADF test, probability of random walk (diff. station.):	Type of variable	ADF test, probability of random walk with drift (diff. station. with trend):	Detrending method
Aid Ec	Stationary	No clear trend	0.0000*	Stationary	-	-
Aid Soc	Stationary	No clear trend	0.0005*	Stationary	-	-
Aid Rec	Stationary	No clear trend	0.0000*	Stationary	-	-
Aid Res	Stationary	No clear trend	0.0000*	Stationary	-	-
lnGDP	Non-stationary	Trend	-	Non-stationary	0.0156	trend
Trade	Non-stationary	No clear trend	1.0000	Non-stationary	-	difference
Pop	Non-stationary	Trend	-	Non-stationary	0.0000	trend
Rural	Non-stationary	Trend	-	Non-stationary	0.0000	trend
Invest	Unclear	No clear trend	1.00000	Non-stationary	-	difference
Gov	Unclear	No clear trend	0.06520	Non-stationary	-	difference
FDI	Non-stationary	No clear trend	0.00000	Stationary	-	-
Dep	Non-stationary	Trend	-	Non-stationary	0.0000	trend
Dem	Stationary	No clear trend	0.00000	Stationary	-	-
Gini	Stationary	No clear trend	0.00000	Stationary	-	-

The table displays the results of a Fisher-type augmented Dickey Fuller panel test on yearly data for the time period 1972-2011 for all 116 countries included in the study. Automatic lag length was used for the random walk test while zero lag length was used for the random walk with drift test.

*Due to the format of the aid data, a unit root test was conducted only on 4 year averages over the time period 1972-2011

tests confirm the expectations in all but one case. Only FDI, which could be expected to increase as developing economies grow, is in fact stationary. The results also demonstrate that the dependent variable is stationary, so cointegration between this variable and the independent variables can be ruled out (Dougherty 2011, p504-505). To achieve stationarity, all non-stationary variables are detrended in the way deemed appropriate by the tests.

An additional assumption of linear regression is that a linear relationship exists between the dependent and independent variables (Dougherty 2011, p.192). However, when more than one explanatory variable is included in the regression, simple scatter plots produce an incorrect overview of the relationship due to the effects of excluded variables that are correlated with the independent variable (Dougherty 2011, p.156) Partial regression plots – scatterplots of the purged dependent and independent variables – are therefore necessary for investigations of linearity as well as outliers when working with multiple regressions (Dougherty 2011, p.195, 156; Fox 1991, pp.36-38, 55). An analysis of the data with the help of partial-regression plots shows a mixture of patterns, ranging from almost evenly spread out data points to possible linearity. Unfortunately, the low number of time periods in the panel does not seem to provide enough data to detect possible trends and outliers. Since linearity between the dependent variable and the regressors is one of the most important assumptions of linear regression, the inability to properly examine this assumption and correct for violations could potentially have serious consequences. Awareness of this shortcoming is important when analyzing the regression results.¹⁴

Linear regression models also assume that the independent variables are not correlated with the disturbance term in any observation (Dougherty 2011, p.301). This assumption will be violated if the independent variable suffers from measurement errors, or if a simultaneous equation bias exists. Both measurement errors and simultaneous equation bias can be addressed with the help of instruments (Dougherty 2011, pp.306-307, p.316, p.333, p.338). Since aid figures are difficult to measure and inequality could affect the amount of aid that a country

¹⁴ One additional remark must be made concerning linearity. Since the dependent variable in the study, the Gini coefficient, by definition is a proportion and only can take values between 0 and 1 (adjusted to 0 and 100 in this study), the effect of the independent variables cannot be constant unless their ranges are very restricted (Papke & Wooldridge, 1996). Consequently, in surveys such as this one, the relationship between the dependent and most independent variables must be nonlinear so linear regression is likely to forecast values that are outside of the dependent variable's range (Grace-Martin, NA; Papke & Wooldridge, 1996). However, if all values of the dependent variable are relatively far from its bounds, all data should be on the linear part of the curve and a linear regression can be used to model the data (Grace-Martin, NA). Since only 9 out of 1151 observations of the Gini coefficient are below the recommended 0.2 minimum limit (most of these are also very close to this limit) and none are above the 0.8 maximum, the use of linear regression should be acceptable in this case.

receives¹⁵, measurement errors and simulation equation bias could be present in the study. Some justification for the use of instruments therefore seems to exist. However, the use of instruments in a panel data setting complicates the analysis considerably. Finding appropriate instruments is also a difficult task, especially when working with panel data (Bjørnskov 2010). Consequently, to simplify the analysis, the impact of simultaneous equation bias and measurement errors is assumed to be limited, and the study does not use any instruments.

7.3 Regression method

With data analysis completed, a Durbin Wu Hausman test was conducted to determine whether fixed effects (FE) or random effects (RE) should be used in the regression (see Table 3 and Table 4 below) (Dougherty 2011, pp.520-521). The redundant fixed effect test rejects the null hypothesis of no effect for both cross section and period, as well as for the combined statistic. The test thereby confirms that both cross section and period effects should be used in the study. In the test for correlated random effects the null hypothesis of no effect between FE and RE fails to be rejected. Since RE is the most efficient method of the two, the test indicates that RE should be used for the cross section. RE cannot, however, be used as period effect in the full regression model since the number of regressors is higher than the number of time periods. In addition, FE cannot be used in combination with RE in an unbalanced data set in the statistical software used for the analysis (EViews). The solution will be to run two versions of the regression, testing the model first with only cross section RE and then with both cross section and period FE.

7.4 Residual examination

Some of the assumptions of linear regression models cannot be examined by looking at the raw data but requires analyses of residuals from a regression. If the assumption of an identical probability distribution, and therefore also identical variance, of the disturbance term for each

Table 3. Redundant Fixed Effects Tests

Effects Test	Statistic	d.f.	Prob.
Cross-section F	13.1780	(111, 524)	0.0000
Period F	5.6789	(8, 524)	0.0000
Cross-Section/Period F	13.1418	(119, 524)	0.0000

Table 4. Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	19.5214	14	0.1460

¹⁵ Research shows that the level of a country's deprivation, for which inequality might be an influencing factor, affects aid allocation (Feeny & McGillivray 2008; Hoeffler & Outram 2011).

of the observations is violated, heteroscedasticity exists (Dougherty 2011, p.280). Tests for heteroscedasticity on panel data are complex and absence of the phenomenon in cases such as for this study, where the sample consists of countries of different sizes, is unlikely. Heteroscedasticity is therefore assumed to be present in this study, so robust standard errors are used to correct for this issue.

Another assumption of the linear regression model that requires an analysis of the residuals is the expectation that the disturbance term is uncorrelated between observations (Dougherty 2011, p.429). Since this study uses panel data, autocorrelation could be a problem in the time dimension. However, as the data has been averaged over 4 year periods, the risk is somewhat reduced. The formal test of autocorrelation in panel data developed by Wooldridge is used to test the data used in the study (Drukker 2003; IHS Global Inc. 2013, pp.772-773). Both the test using FE and RE reject the null hypothesis of no serial correlation (see Appendix A.2). Standard errors robust to autocorrelation in the time dimension should therefore be used. Since cross section serial correlation is rare, and no special reason to suspect it in this study exists, tests for correlation between countries' disturbance terms have not been conducted.

Both heteroscedasticity and autocorrelation are addressed with White period robust standard errors. This method corrects for heteroscedasticity and serial correlation in the error terms of a country (cross-section clustered) (IHS Global Inc. 2013 p.731).¹⁶

Linear regression also assumes that the disturbance term is a random variable with a normal distribution (Dougherty 2011, p.114). The assumption can be tested by checking whether the residuals are normally distributed. Smaller deviations from normality do not generally pose any problem, but a very non-normal distribution can cause problems with F- and t-tests, as well as p-values (Montgomery et al. 2010, p.136). Although strictly speaking only valid for very large samples, the Jarque-Bera test will be used to evaluate the normality of the residuals of the regressions run in the study (Mukherjee et al. 2013, p.95).

7.5 Regression approach

One final note on the methodology used is needed. To better be able to follow the effect that the control variables have on aid, these variables will be added to the regression one at a time. A review of the impact of additional control variables is included in the discussion of the results.

¹⁶ Using Period SUR (PCSE) robust standard errors causes only minor changes. Period SUR (PCSE) corrects for country heteroscedasticity and serial correlation as well as cross-section correlation but places extra assumptions on the model and is therefore not used as the default for the study (Chen et al. 2010; IHS Global Inc. 2013, p.732).

8. Results

8.1 Random effects

According to the Durbin Wu Hausman test, RE is the preferred method for the study. However, since the number of regressors is higher than the number of time periods, period RE cannot be used so regressions are run with only cross section RE. As control variables are added to the regressions, the coefficient of determination increases from 2% to 14.5%. A coefficient of determination of 14.5% implies that the regression explains only a smaller proportion of the variation in the dependent variable. However, the fact that the F-tests of the regressions are significant indicates that the model still has explanatory power (Dougherty 2011, p.178). All regressions are also showing normally distributed residuals, indicating that tests should be reliable.

Signs on the control variables are all as expected, with the exception of FDI that remains negative throughout all regressions, and trade that changes between negative and positive values. However, the null hypothesis of no effect from trade or FDI cannot be rejected so the unexpected signs seem to be due to random fluctuations.

With the test statistics and signs of the control variables showing no particular reasons for concern, focus can be shifted to the variables of interest. Current economic and social aid both have positive signs on their coefficients. These results support the theoretical predictions that aid increases inequality. The first lags of these two variables are not significant and are therefore removed from the model. The results for reconstructional and residual aid are more interesting; both current and first lagged residual as well as lagged reconstructional aid variables have negative signs, indicating that increased aid of these types decreases inequality. As control variables are added to the model, the signs of the aid variables remain the same.

Several control variables do, however, affect the size and significance of the aid variables. As the dependency ratio is added to the model, the magnitude of economic aid decreases with around 14%, while reconstructional and residual aid increase with around 16% and 3% respectively. Coefficients for social aid, lagged reconstructional aid and lagged residual aid all change in size with approximately 10%, the latter growing while the two former decrease. Adding GDP causes coefficients to increase with a bit more than 10% for economic aid and 30%-50% for social aid, and to decrease with a bit more than 15% for residual aid. Coefficients for lagged reconstructional and residual aid both decrease less than 5%.

The addition of democracy has a rather large effect on all current aid variables. The

coefficient of economic aid decreases with 25%-30% while social aid and reconstructional aid increase with around 16% and 13% respectively. Residual aid decreases with less than 5%. FDI causes the coefficient for economic aid to increase with around 10%-20%, while residual aid's coefficient increases with around 10% for both current and lagged aid. The lagged reconstructional aid's coefficient decreases with around 20%.

The regression output for the complete model can be found in Table 5. The table shows that neither social nor reconstructional aid have any effect on inequality. However, the first lag of reconstructional aid is significant. Also economic aid and current and lagged residual aid are significant (the lagged variable only at 10%).

The regression estimates of the coefficients show the effect that an increase of a one percentage point of aid, measured as a percentage of GDP¹⁷, will have on the Gini coefficient. A look at the coefficient of lagged reconstructional aid shows that a one percentage point

Table 5. Regression output of complete model with RE

Periods included: 9

Cross-sections included: 112

Total panel (unbalanced) observations: 628

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	41.5415	0.8863	46.8688	0.0000
AIDEC	2.0078	0.7280	2.7579	0.0060***
AIDSOC	0.6492	0.5293	1.2266	0.2205
AIDREC	-0.7981	0.7814	-1.0214	0.3075
AIDRES	-8.5605	3.1847	-2.6880	0.0074***
LNGDP	26.1031	10.4474	2.4985	0.0127**
LNGDPSQ	-1.2770	0.6202	-2.0590	0.0399**
TRADE	0.0353	0.5308	0.0665	0.9470
POP	0.0071	0.0025	2.8555	0.0044***
RUR	-0.0655	0.0416	-1.5744	0.1159
INV	-0.2158	0.7630	-0.2829	0.7774
GOV	-3.0287	1.0632	-2.8487	0.0045***
FDI	-0.0563	0.0847	-0.6645	0.5067
DEP	0.1975	0.0460	4.2961	0.0000***
DEM	0.1867	0.1178	1.5846	0.1136
AIDREC(-1)	-5.5919	1.7511	-3.1934	0.0015***
AIDRES(-1)	-5.4652	2.8925	-1.8895	0.0593*
R-squared	0.1456	F-statistic	6.5056	
Adjusted R-squared	0.1232	Prob(F-stat.)	0.0000	

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

¹⁷ For clarity, written simply as "aid" for the remainder of the section.

increase in this type of aid in the previous 4-year period causes inequality to decrease with 5.59 Gini coefficient units in this 4-year period if all else is held constant.¹⁸ The coefficient for economic aid indicates that, holding all else equal, a one percentage point increase in economic aid in the current time period increases the Gini coefficient with 2.01 units. For residual aid, a one percentage point increase in the current period causes the Gini coefficient to decrease with 8.56 units, while a one percentage point increase in the previous 4-year period causes a decrease of 5.46 Gini coefficient units in the current period, *ceteris paribus*.

Among the control variables, a smaller number of variables are significant. Both GDP and its square belong in this group. Since GDP has been detrended and is both logarithmized and nonlinear, the interpretation of its coefficient is less straightforward and its effect varies with GDP (see Appendix A.3). Consequently, a 1 million USD increase of GDP over its trend causes a $26.1031/GDP_{it} - [2.5540*\ln(GDP_{it})]/GDP_{it}$ increase in the Gini coefficient. Government intervention is also significant with a coefficient that indicates that a one percentage point increase in intervention¹⁹ causes the Gini coefficient to decrease with 0.03²⁰ units. Significant p-values exist for two more variables: the dependency ratio and population growth. Their coefficients show that a one percentage point increase over the dependency ratio trend causes inequality to increase with 0.20 Gini coefficient units, while a one percentage point increase over the population trend causes a 0.01 increase of the Gini coefficient.

Theoretically, a longer delay in the effects of aid is possible. Running the regression with more than one lag could therefore reveal more about aid's impact on inequality and potentially also improve the goodness of fit of the model. Adding additional lags makes residual aid significant in both the second and the third lags. The inclusion of the extra lags has a substantial impact on a number of other variables, most notably making economic aid insignificant, and investment and social aid significant (the latter at 10% level). The coefficient of determination is slightly higher at 15.4%. Running the regression without variables for current aid has little effect - lagged reconstructional and residual are still the only significant variables but the coefficient of determination decreases to 12.7%.

8.2 Fixed effects

To be able to conduct regressions with period specific effects as well as country effects, the

¹⁸ In accordance with standard practice, Gini coefficients are rounded to the closest second decimal.

¹⁹ Government intervention is proxied by government consumption, calculated as a percentage of GDP.

²⁰ All variables that are detrended using differencing are in decimal rather than percentage form, so a one percentage point increase in government intervention causes a $\beta_2/100$ increase in the Gini coefficient.

FE approach is used for both dimensions. As before, control variables are added one by one to the basic model of income inequality regressed on lagged and current aid. All regressions have coefficients of determination of 78%-80% but since the coefficient is calculated based on differences between the complete FE model and a model with a common intercept, the high value is likely due to significant country and/or time effects (Eviews support 2012). All F-tests of the regressions are significant. Jarque-Bera tests show that none of the regressions using FE have a normal distribution of the residuals. Since the assumption of a normal distribution is one of the least important assumptions of linear regression unless the data is used to make predictions for particular data points, indications of non-normality should not be a serious problem (Gelman 2013). Signs on all control variables are as expected; only rural population has coefficients that varies between negative and positive values. Since this variable is insignificant, the negative values are likely random occurrences.

Focusing on the variables of interest shows that the signs on the aid variable coefficients are identical to the RE regressions: economic and social aid have positive signs and current and lagged reconstruction and residual aid have negative signs. Lagged economic and social aid are again not significant and are therefore removed from the model.

As certain control variables are added, some larger changes in the size of the coefficients and significance of the aid variables can be observed. When GDP is added to the model, coefficients for both economic and social aid increase with around 20%-40% while reconstructional aid's coefficient increases with less than 5%. Adding FDI also affects a number of aid variables. Current and residual aid coefficients increase with around 10% and 15% respectively, while economic aid increases with 15%-30%. Both current and lagged reconstructional aid's coefficients decrease with around 15%.

Government intervention is another influential variable. The coefficients of residual and social aid increase with around 15% and less than 5% respectively, and coefficients of both reconstructional and residual lagged aid decrease with around 10% when government intervention is added to the model. Finally, democracy and the dependency ratio each affect one aid variable strongly. When democracy is added to the model, economic aid's coefficient decreases with about 30%. The dependency ratio causes reconstructional aid's coefficient to grow with about 10%.

The regression output for the complete model can be found in Table 6. Current reconstructional aid is the only aid variable that is not significant. However, the first lag of this variable is significant. Economic, social and current as well as lagged residual aid are all significant only at the 10% level. The regression coefficients show that for each one

percentage point increase in aid²¹ to reconstructional purposes in the previous 4-year period, inequality decreases with 4.43 Gini coefficient units in this period, ceteris paribus. A one percentage point increase in economic aid causes inequality to increase with 1.93 units on the Gini index, while a one percentage point increase of aid going to the social category increases inequality with 1.03 units on the Gini index, ceteris paribus. For aid to the residual category, a one percentage point increase of aid while holding all else constant decreases inequality with 5.94 units on the Gini index. Finally, a one percentage point increase in lagged residual aid in the previous 4-year period causes inequality to decrease with 4.42 Gini coefficient units in this period, ceteris paribus.

Among the control variables, only GDP, democracy and government intervention are significant. The square of GDP is insignificant, indicating an absence of Kuznets inverted U-shaped curve, and a linear effect of GDP. Since GDP has been logarithmized, the coefficient

Table 6. Regression output of complete model with FE

Periods included: 9

Cross-sections included: 112

Total panel (unbalanced) observations: 628

WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	41.0061	0.8162	50.2375	0.0000
AIDEC	1.9334	0.9873	1.9581	0.0508*
AIDSOC	1.0284	0.5469	1.8805	0.0606*
AIDREC	-1.4859	1.2563	-1.1827	0.2375
AIDRES	-5.9427	3.3689	-1.7640	0.0784*
LNGDP	21.9348	11.1230	1.9720	0.0492**
LNGDPSQ	-1.0097	0.6774	-1.4906	0.1367
TRADE	-0.3172	0.7265	-0.4367	0.6625
POP	0.0167	0.0148	1.1324	0.2580
RUR	-0.0369	0.1125	-0.3281	0.7430
INV	-0.5466	0.7921	-0.6901	0.4905
GOV	-3.8212	1.1401	-3.3517	0.0009***
FDI	0.0199	0.0880	0.2262	0.8212
DEP	0.1047	0.0664	1.5765	0.1156
DEM	0.3812	0.1740	2.1903	0.0290**
AIDREC(-1)	-4.4348	2.2542	-1.9674	0.0497**
AIDRES(-1)	-4.4215	2.5415	-1.7397	0.0825*
R-squared	0.8013	F-statistic	14.7000	
Adjusted R-squared	0.7468	Prob(F-stat.)	0.0000	

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

²¹ As in the previous section, aid is measured as a percentage of GDP but will for clarity be written simply as "aid" for the remainder of this section.

of 21.9347 means that holding all else equal, a 1 million USD increase in GDP causes a $21.9347/GDP_{it}$ unit increase of the Gini coefficient (see Appendix A.4.). The coefficients also show that a one-unit increase in the Polity IV measure of democracy increases the Gini coefficient with 0.38, while a one percentage point increase in government intervention would cause a decrease of 0.04²² units on the Gini index, *ceteris paribus*.

Regressions with more lags were also tested, but no additional significant variables were found. When estimating the regression without current aid, lagged reconstructional and residual aid remain the only significant variables (the latter only at the 10% level).

²² All variables that are detrended using differencing are in decimal rather than percentage form, so a one percentage point increase in government intervention causes a $\beta_2/100$ increase in the Gini coefficient.

9. Conclusion

Despite strong indications that inequality can have adverse effects on development, surprisingly few studies have investigated the relationship between aid and inequality. The results from the existing research are mixed, and only a couple of studies look at whether the intended use of aid makes any difference on the relationship to inequality. The purpose of this study is to help bring clarity to the question of whether foreign aid, and in particular different types of it, affects inequality. The aid data used in the study is therefore separated into four statistically valid categories - economic, social, reconstructional and residual - based on its intended use. The results from FE and RE regressions on a panel data of 116 countries over the period 1972-2011 show that a relationship exists between all types of aid and inequality.

Economic and social aid both have a positive relationships to inequality. The results therefore support the theoretical models that predict that aid will increase inequality. The results are, however, somewhat weak. Although economic aid is significant at 1% in the RE regression, both variables are only significant at 10% in the more reliable FE model. Theoretically, these two variables are likely to affect inequality through GDP and governmental intervention, which reduces the visibility of their effects in a regression analysis. GDP and governmental intervention are also significant in both the RE and FE regressions, so the weak effect of economic and social aid could be a result of the fact that these control variables are included in the model.

The results for reconstructional and residual aid are more unexpected. Contrary to what the theoretical models predict for overall aid, these variables exhibit a negative relationship to inequality (with the exception of current reconstructional aid which is insignificant). It is important to point out at this point that no test of the direction of the effect has been conducted. Although the regression model implicitly implies that aid causes inequality, it is possible that the effect goes the opposite way. Aid could be allocated primarily to the countries that suffer greater inequality, due to an association with poverty. The following paragraphs will generally assume that inequality is the dependent variable, but it is important to be aware that causality could run from inequality to aid.

The fact that reconstructional aid is not significant until in the first lag is less of a surprise when looking at the composition of this type of aid. The main components of reconstructional aid are emergency response and reconstruction relief. Projects in these areas can generally be expected to be large and time consuming, but should have a substantial effect on a society once finished. At the same time, such projects are more likely to be a one-off occurrence or to be conducted for a limited time period only, so the apparent lack of

significance of the variable in further lags is not unexpected.

The negative relationship between residual aid and inequality is particularly interesting, especially since the results suggest that the effect of this type of aid might persist for more than a decade. Although the scope of this study does not provide any basis for drawing conclusions as to why aid affects inequality, it is interesting to note that all aid aimed specifically at projects for women is included in the residual category. Studies show that women's situation are a likely determinant of their children's future situation, so investments in women have large possibilities to affect future generations (Todaro & Smith 2011, p.240). The long effect of residual aid would fit well with processes such as this.

Some caution must, however, be observed when evaluating results from regressions with several lags. An important disadvantage of using many lags in an unbalanced panel is the often large decrease in the number of observations available for the regression. For an unbalanced panel with as few time periods as this one (10), the effect of using 3 lags will be considerable. The results from the model with several lags should therefore be considered preliminary.

A couple of concerns about the quality of the regression results should also be addressed. A surprising result in the study is the lack of significance of so many of the control variables. Even though the theoretical discussion demonstrates that there are valid reasons for including the variables, regressions show that only three (five) variables are significant in the FE (RE) regression. However, although they are not significant, virtually all control variables have the expected signs.

A more serious problem is the fact that linearity could not be tested. Violations of the linearity assumption can cause coefficient estimates to be incorrect, so the failure to test this assumption means that the results of the study must be seen as tentative. Future studies will hopefully have access to more comprehensive data, especially in the time dimension, so that more reliable results can be produced. Alternatively, a replication of the study using more complex econometric methods that can account for possible nonlinearity would be welcome.

In short, the results of the study suggest that all types of aid have a relationship to inequality, and that the purpose of the aid matters. If the causation indeed runs from aid to inequality, the study findings indicate that aid should be focused on projects belonging in the residual aid category if inequality is to be lowered. Also projects that address emergencies or reconstruction needs are helpful in decreasing inequality, although the effect seems to be more temporary.

Appendix A

A.1 Fisher-Type Augmented Dickey Fuller Unit Root Test for Panel Data

A non-stationary variable can have both an autoregressive component as well as a time trend, so the complete possible model is:

$$Y_t = \beta_1 + \beta_2 * Y_{t-1} + \beta_3 * t + u_t$$

(Dougherty 2011, pp.489-490). If no trend is visible in a plot of a variable over time, only two options are possible, a stationary process or a random walk:

$$Y_t = \beta_1 + \beta_2 * Y_{t-1} + u_t$$

$$Y_t = Y_{t-1} + u_t$$

(Dougherty 2011, p.491). Assuming absence of a trend, a Fisher-type augmented Dickey Fuller (ADF) unit root test for panel data on a model without a trend will determine whether non-stationarity in the shape of a random walk exists ($\beta_2 = 1$ or $\beta_2 < 1$). The Fisher ADF test allows individual unit root processes for each cross section and combines these into an overall panel result (IHS Global Inc. 2013, p. 492).

If a trend is visible in the plot of a variable over time, the two possible models are a random walk with drift or a deterministic trend

$$Y_t = \beta_1 + Y_{t-1} + u_t$$

$$Y_t = \beta_1 + \beta_2 * Y_{t-1} + \beta_3 * t + u_t$$

(Dougherty 2011, p.497). A Fisher-type ADF unit root test on a model with a trend and an intercept can then determine which kind of stationarity exists in the data ($\beta_2 = 1$ or $\beta_2 < 1$). Whether $\beta_3 = 1$ or $\beta_3 \neq 0$ follows as a consequence of the unit root's existence or not.

A.2 Wooldridge's panel test for autocorrelation

The following discussion is based on Drukker (2003). In the basic panel regression model,

$$Gini_{it} = \alpha_i + \beta_1 + \beta_2 X_{it} + u_{it},$$

where $Gini_{it}$ is the Gini coefficient, α_i is individual specific effects, β_1 is the basic intercept, X_{it} is a set of regressors and u_{it} is the error term.

By taking first differences, only the dependent and independent variables as well as the error term are left in the model:

$$Gini_{it} - Gini_{it-1} = \alpha_i + \beta_1 + \beta_2 X_{it} + u_{it} - (\alpha_i + \beta_1 + \beta_2 X_{it-1} + u_{it-1})$$

$$\Delta Gini_{it} = \Delta \beta_2 X_{it} + \Delta u_{it}$$

Regressing this model gives residuals, res_{it} , that are the sample values for the error term Δu_{it} . Wooldridge points out that if no serial correlation between error terms exist, $Corr(\Delta u_{it}, \Delta u_{it-1}) = -0.5$. Consequently, regressing res_{it} on res_{it-1} produces a coefficient that is $Corr(\Delta u_{it}, \Delta u_{it-1})$, and a simple F-test can be used to determine whether the value differs from -0.5.

For the tests in this study, p-values of 0.0000 demonstrate that the null hypothesis of no autocorrelation can be rejected even at 1%.

Table A.1. Wooldridge's autocorrelation test (RE)

Test Stats.	Value	df	Probability
F-statistic	302.7683	(1, 426)	0.0000

Null Hypothesis: $C(1)=-0.5$

Residuals are from a regression model using RE.

Table A.2. Wooldridge's autocorrelation test (FE)

Test Stats.	Value	df	Probability
F-statistic	184.5823	(1, 426)	0.0000

Null Hypothesis: $C(1)=-0.5$

Residuals are from a regression model using FE.

A.3 Marginal effect of the nonlinear variable GDP

A variable's marginal effect is the derivative of the regression model (Dougherty 2011, p.209). Consequently, for a nonlinear and logarithmized variable such as GDP, the marginal effect is:

$$Gini_{it} = \beta_1 + \beta_2 AidV_{it} + \beta_3 X_{it} + \beta_4 * [ln(GDP_{it})] + \beta_5 * [ln(GDP)]^2_{it} + u_{it}$$

$$\partial Gini_{it} / \partial GDP_{it} = \beta_4 / GDP_{it} + [2 * \beta_5 * ln(GDP_{it})] / GDP_{it}$$

In this particular case, the marginal effect is therefore:

$$\partial Gini_{it} / \partial GDP_{it} = 26.1031 / GDP_{it} + [2 * (-1.2770) * ln(GDP_{it})] / GDP_{it}$$

$$\partial Gini_{it} / \partial GDP_{it} = 26.1031 / GDP_{it} - [2.5540 * ln(GDP_{it})] / GDP_{it}$$

A.4 Marginal effect of GDP in FE regression

Again, a variable's marginal effect is the derivative of the regression model (Dougherty 2011, p.209). With the complete model,

$$Gini_{it} = \beta_1 + \beta_2 AidV_{it} + \beta_3 X_{it} + \beta_4 * [ln(GDP_{it})] + u_{it},$$

the derivative becomes:

$$\partial Gini_{it} / \partial GDP_{it} = \beta_4 / (GDP_{it})$$

Appendix B

Table B.1. Countries in study

Angola	Cote D'Ivoire	Honduras	Lithuania	Pakistan	Tajikistan
Albania	Cameroon	Croatia	Latvia	Panama	Turkmenistan
Argentina	Colombia	Hungary	Morocco	Peru	Trinidad and Tobago
Armenia	Comoros	Indonesia	Moldova	Philippines	Tunisia
Azerbaijan	Cape Verde	India	Madagascar	Poland	Turkey
Burundi	Costa Rica	Iran	Maldives	Paraguay	Tanzania
Benin	Djibouti	Iraq	Mexico	Romania	Uganda
Burkina Faso	Dominican Republic	Jamaica	Macedonia FYR	Russia	Ukraine
Bangladesh	Ecuador	Jordan	Mali	Rwanda	Uruguay
Bulgaria	Egypt	Kazakhstan	Montenegro	Senegal	Uzbekistan
Bosnia-Herzegovina	Estonia	Kenya	Mongolia	Sierra Leone	Venezuela
Belarus	Ethiopia	Kyrgyz Republic	Mozambique	El Salvador	Vietnam
Belize	Fiji	Cambodia	Mauritania	Serbia	Yemen
Bolivia	Gabon	Korea	Mauritius	Suriname	South Africa
Brazil	Georgia	Laos	Malawi	Slovak Republic	Zambia
Barbados	Ghana	Lebanon	Malaysia	Swaziland	Zimbabwe
Bhutan	Guinea	Liberia	Namibia	Syria	
Botswana	Gambia	St. Lucia	Niger	Chad	
Chile	Guinea-Bissau	Sri Lanka	Nigeria	Togo	
China	Guatemala	Lesotho	Nepal	Thailand	

Table B.2. Previous research on aid's effect on inequality

Study	Effect of aid on inequality	No. countries; time period	Method	Primary aid measure; data source aid	Inequality measure	Data source inequality
Cuesta et al. 2006	Negative if given during a longer period, regional variations of the strength of the effect exists	30; 1995-1998	Ordered probit	Aid per capita; annual variation; World Bank (OECD)	Gini coefficient, interval ratings	Living Standards Measurement Study of the World Bank; United Nations University's World Income Inequality Database, WIID, v 1.0
Chong et al. 2009	No effect; when taking the quality of institutions into account, aid reduces inequality but the effect is not robust	116; 1971-2002	Fixed effects dynamic panel data Generalized Method of Moments (GMM)	Percentage of GDP; ODA disbursement and commitments, OECD; Effective Development assistance (EDA), Chang et al. 1999 (World Bank)	Gini coefficient	United Nations University's World Income Inequality Database, WIID
Layton & Nielson 2009	No effect; positive effect in many cases but few are significant and robust	82; 1975-2005	Fixed and random effects Ordinary Least Squares (OLS) and Two Stage Least Squares (2SLS)	Log of aid per capita; World Development Indicators, WDI, World Bank (OECD)	Gini coefficient	University of Texas Inequality Project
Bjørnskov 2010	Positive relationship of aid and inequality in democracies; no effect in autocracies	88; 1960-2000	Random effects weighted least squares (WLS)	Log of percent of GDP; ODA, OECD	Shares of the population belonging to each of the five income quintiles	United Nations University's World Income Inequality Database, WIID
Shafiullah 2011	Negative effect; unclear effect in South Asia	94; 1989-2008	Fixed and random effects regressions	Net aid growth rate; ODA, World Bank (OECD)	Gini coefficient	Standardized World Income Inequality Database, SWIID

Table B.2. Previous research on aid's effect on inequality (cont.)

Study	Effect of aid on inequality	No. countries; time period	Method	Primary aid measure; data source aid	Inequality measure	Data source inequality
Herzer & Nunnenkamp 2012	Positive effect	21; 1970–1995	Panel cointegration on a bivariate model	Percentage of GDP; Net Aid Transfers (NAT), Center for Global Development	Gini coefficient	University of Texas Inequality Project
Saidon et al. 2013	Aid to the economic sector has a negative effect, aid to the multi-sector has a positive effect, aid to the social and production sectors has no effect	75; 1995–2009	Generalized Method of Moments (GMM)	Log of percentage of GDP; ODA, OECD	Gini coefficient	Standardized World Income Inequality Database, SWIID
Tezanos et al. 2013	Latin America & the Caribbean: Negative effect; grants have smaller effects than loans	20; 1992–2007	Growth model estimated with Generalized Method of Moments (GMM)	Net disbursement; percentage of GDP; ODA, OECD	Growth rate of GDP per capita of the population in the nine poorest deciles	United Nation's Economic Commission for Latin America (ECLA)□

Table B.3. Categorization of aid

	Percentage of aid in AidData's purpose code assigned to			
	Economic purposes	Social purposes	Reconstruction purposes	Residual group
Agriculture, forestry and fishery	64	36		
Banking and financial services				100
Business and other services		100		
Communications	100			
Development aid, food security assistance	100			
Disaster prevention and preparedness				100
Education	44	56		
Emergency response			100	
Energy generation and supply	100			
General budget support		100		
General environmental protection		100		
Government and civil society		52	48	
Health	33	67		
Industry, mining, construction	100			
Other		100		
Other commodity assistance	100			
Other social infrastructure and services		100		
Population policies / Programs and reproductive health		55		45
Reconstruction relief			100	
Support to NGOs and government organizations				100
Trade and tourism				100
Transport and storage	100			
Water supply and sanitation	62	38		
Women				100

The table displays how much of aid in each of AidData's purpose codes is classified into each of the four statistically valid aid categories that Bjørnskov (2013) developed.

The following purpose codes are excluded from the analysis since aid classified into these codes does not meet all the criteria of being grants going to a specific developing country for aid purposes that are not humanitarian: Action relating to debt, Humanitarian aid, Administrative costs of donors, Refugees in donor countries, Unallocated / unspecified

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