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A Wider Approach to Aid Effectiveness

Correlated Impacts on Health, Wealth, Fertility and Education

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Abstract

In this paper we discuss the results of research into the impact of foreign aid on human development. Rather than focussing on per capita income, as is common in the existing literature, we look at how aid impacts on a range of human development indicators, including measures, of health, education and fertility, and allow for the fact that these different dimensions of wellbeing are likely to interact with each other. Overall, aid is found to have a substantial positive impact on many development outcomes.

Keywords: aid, health, wealth, fertility, education
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1 Introduction

The 2005 G8 summit in Scotland focussed attention on the commitment of the industrialized world to promoting economic/social development in Africa and other parts of the developing world. The debates about aid delivery took place in an atmosphere of scepticism about the benefits that foreign aid might bring. For example, at the time of the summit, many newspapers reported recent IMF research casting doubt at the effectiveness of aid expenditure.[1] This pessimistic news contrasts strongly with some of the recent academic literature. The balance of evidence in the academic literature—which has not received a great deal of attention outside the academic community—is that, on average, aid does have some beneficial impact on human development (Addison et al. 2005; Clemens et al. 2004). This is not to say that aid will ever close the income gap between the northern and southern hemispheres, but rather that aid recipients experience better development outcomes, on average, than they would in the absence of aid.

The research which the newspaper reports were publicizing illustrates some of the difficulties involved in researching aid effectiveness. First of all in producing robust estimates of the impact of aid on recipient countries, and secondly in communicating these results to a wider audience. In fact, there is a marked difference in tone between the newspaper reports above and the research paper they were quoting. This paper (Rajan and Subramanian 2005) actually states that '[a]id inflows do have systematic adverse effects on growth … in labour intensive and export sectors', but that '[w]e have not established whether these adverse competitiveness effects offset any beneficial effects of aid'. They emphasize that '[a]id has to be spent really effectively so that the productivity improvements … offset any dampening effects from a fall in competitiveness'. As usual, the academic research is less categorical and more hedged with doubt. But what are the reasons for uncertainty in this case? Why can economists not work out how foreign aid affects the countries to which it is directed? There are two key problems.

In the next section, we review the key difficulties in establishing empirical evidence on the effects of aid. Section 3 then illustrates how we might chart a way though these difficulties.

[1] With headlines such as 'Aid will not boost growth, warns IMF' (*The Age*, 04.07.05); 'Aid will not lift growth in Africa, warns IMF' (*Financial Times*, 29.06.05); and 'IMF: Cash Alone Won't Solve Africa's Ills' (*Iran Daily,* 02.07.05).

2 Why is it so difficult to determine the effects of aid?

2.1 First problem: identification of the treatment effect

Poor countries receive more aid (on average) than rich ones. A simple comparison of conditions in countries with aid to conditions in those without does not demonstrate the effect of aid. (Hospitals are full of sick people, but it does not mean that the hospitals made them sick.) To identify the effect of aid on an indicator of social or economic development, we need to find an *instrument*, a third variable that is independent of both, and that has a direct effect on aid only (not on the development indicator; this is an exclusion restriction). If our indicator varies systematically with this third variable, then we have demonstrated an aid effect, because, by assumption, the only way our indicator could have been affected is through aid.

But this approach relies on assumptions about how the three variables are connected; no study can ever be 100 per cent watertight. Any results from the statistical analysis are predicated on the independence of the instrument and on the exclusion restriction. Therefore, all results about the effectiveness of aid are necessarily provisional. In many cases, it is possible to question the validity of the exclusion restriction. For example, Rajan and Subramanian use information about developing countries' colonial ties as an instrument. The argument is the that former colonial powers are more inclined to give aid to their former colonies, so a developing country with a colonial tie to one of the relatively prosperous industrialized countries is likely to receive more aid, ceteris paribus. However, the exclusion restriction here can be questioned: colonial ties could also promote trade between the developing country and its former occupier, in which case aid is not the only route through which colonial ties impact on economic development.

2.2 Second problem: how is 'development' to be measured?

Aid might affect a wide variety of social and economic indicators. In order to identify the degree of aid effectiveness, we need to establish which indicators are important, and how the different indicators interact. A multivariate approach to the problem is a key to its solution, because there may be many virtuous spirals between different dimensions of development. It is unfortunate then that most papers examining aid effectiveness measure development only in terms of material wellbeing, specifically, in terms of average personal income in a region. In cross-country growth studies, the norm is to use PPP-adjusted per capita GDP or GNP.[2] There are a number of reasons why PPP-adjusted per capita income may be an unsatisfactory measure of material wellbeing. The price data on which PPP adjustments are based are collected only in certain countries and certain years. PPP adjustments for other countries and years, especially in the developing world, are based on extrapolations that may embody large measurement

[2] See Summers and Heston (1991) for a description of PPP adjustment to national accounts data.

errors. Moreover, the prices used make little or no adjustment for variations in the quality of goods and services. Perhaps more importantly, many of the key goods and services that make a large difference to the utility of low-income households are consumed jointly by all the members of a single household. Examples include access to piped water and a flush lavatory, and the use of a refrigerator or radio. In this case per capita measures of prosperity may be less informative than measures based on assets per household.

There already exist empirical studies relating to the connections between different dimensions of development, not just material wellbeing, but they typically focus on a single link in the chain. There are studies of the impact of a region's education on its income (for example, Teulings and van Rens 2003), of income on education (for example, Fernandez and Rogerson 1997), of income on health (for example, Pritchett and Summers 1996), of health on income (for example, Bloom et al. 2004), of fertility on income (for example, Ahlburg 1996) and of income on fertility (for example, Strulik and Siddiqui 2002).[3] Many of these studies present careful and compelling evidence on their chosen area of research, but taken as a whole they embody certain limitations. The heterogeneity of statistical methodologies and datasets across these papers means that they do not shed any collective light on the relative importance of the different causal links in the overall development process. It would be useful to know, for example, if any one link is particularly strong, and hence a potential focus for development policy and expenditure.

Moreover, most existing cross-country studies use data on the average value of the development indicators in each country. The main aim of most empirical economic research has been to explain correlations in these indicators at the national level. Researchers in education and health sciences have often been more sensitive to the drawbacks of such an approach.[4] They point out that using mean income places a large weight on the income of the rich, because income distributions are left-skewed, so the mean figure reported for a country is higher than the median. Looking at the link between variations in mean income and, say, variations in infant mortality might be misleading, because high infant mortality is a consequence of the poverty of middle- and low-income groups in a developing country. One way of addressing this problem might be to include a measure of income distribution in the empirical model; however, a more direct approach would be to measure separately the income and health status of the rich and poor within a country.

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[3] Briefly, the theoretical rationale for the effects is as follows. Higher standards of education and health embody human capital investments that increase productivity and so per capita income. Higher fertility entails a higher rate of population growth, and so a lower capital-labour ratio and (with decreasing returns to labour) lower productivity. Education and health are also normal consumption goods, so expenditure on them increases with per capita income. High fertility is a consequence of a low opportunity cost of labour (especially female labour), and is therefore decreasing in per capita income.

[4] See for example Dean Jamison's comments at the IMF Economic Forum *Health, Wealth and Welfare*, 15 April 2004 (www.imf.org/external/np/tr/2004/tr040415.htm).

3 A solution to these problems

In this section we illustrate how one might go about dealing with the problems listed above, drawing on the methodology and results presented in Fielding et al. (2005). This methodology differs from existing work on aid effectiveness in several ways. Most importantly, it does not use GDP as a development indicator. No reference is made to per capita income. Instead, the model employs a measure of the material assets that the household possesses, using data on material assets in forty-eight countries in the World Bank Health, Nutrition and Poverty (HNP) database. These countries are listed in Table 1. The assets recorded in the survey are basic enough for differences in quality across countries not to be a major worry. This approach also avoids any reference to PPP adjustments.

Table 1: Countries included in the analysis

	Survey year		Survey year		Survey year		Survey year
Bangladesh	2000	Dom. Rep.	1996	Madagascar	1997	Paraguay	1990
Benin	2001	Egypt	2000	Malawi	2000	Peru	2000
Bolivia	1998	Ethiopia	2000	Mali	2001	Philippines	1998
Brazil	1996	Gabon	2000	Mauritania	2001	Rwanda	2000
Burkina Faso	1999	Ghana	1998	Morocco	1992	S. Africa	1998
Cambodia	2000	Guatemala	1999	Mozambique	1997	Tanzania	1999
Cameroon	1998	Guinea	1999	Namibia	2000	Togo	1998
C.A.R.	1995	Haiti	2000	Nepal	2001	Uganda	2001
Chad	1997	India	1999	Nicaragua	2001	Vietnam	2000
Colombia	2000	Indonesia	1997	Niger	1998	Yemen	1997
Comoros	1996	Jordan	1997	Nigeria	1990	Zambia	2002
Cote d'Ivoire	1994	Kenya	1998	Pakistan	1990	Zimbabwe	1999

Source: Fielding et al. (2005).

The household assets index is calculated by combining information about whether the household has the following material assets: a wooden or concrete floor, a radio, a television, electric power supply, a refrigerator or a car. The index is constructed for each household on a scale of zero to one, and then average figures are constructed for the 20 per cent of households ranked lowest by this measure, and for the four quintiles above them.[5] The household-level information is aggregated to the quintile level, and

[5] More details about data construction are available in Fielding and Torres (2005).

not used directly, because it is not possible to find reasonable exclusion restrictions at the household level.

In addition to this measure of material wellbeing, the model also incorporates data measuring four other dimensions of development, namely, standards of sanitation, fertility, health and education. S*anitation* is measured in two alternative ways: first, the proportion of households within each quintile with access to piped water, and second, the proportion of households within each quintile using a 'bush latrine'.[6] *Fertility* is measured by the average number of live births per adult female in each of the five quintiles.[7] In measuring *health*, three alternatives are considered: the infant mortality rate; the child mortality rate; and life expectancy. Finally, *education* is measured by the proportion of adults in each quintile who have completed primary school. Appendix 1 lists the sample means and standard deviations of these five variables.

Illustrative statistics from Burkina Faso and Paraguay are presented in Tables 2 and 3. Burkina Faso represents one of the poorest countries in our sample All but the wealthiest households lack electricity, piped water and basic sanitation, and few have any education. Even many of the wealthiest lack basic facilities. In contrast, Paraguay represents a country at a further stage of development, with even the poorest households better off by some measures than the richest in Burkina Faso. Still, many of the poor in Paraguay lack sanitation and have higher fertility and infant mortality rates than the rich.

Each of these dimensions of human development potentially has an impact on the others. Modelling all five simultaneously facilitates identification of the linkages that are quantitatively the most important, and also the most quantitatively important channels through which aid has an effect. Moreover, in measuring development for asset quintiles within a country, rather than just the average for the country as a whole, the model gives equal weight to the development outcomes of the rich and the poor within a country.

All five development indicators are measured for each of the five quintiles in each of the 48 countries, so the dataset on which our estimates are based incorporates 240 observations on each indicator. Observations in each country are made in a single year, as noted in Table 1, so our dataset is not a panel in the traditional sense. Using these data, it is possible to see how the variation in development outcomes in each quintile in

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[6] This is a euphemism for the complete absence of sanitary facilities.

[7] One alternative measure of fertility is live births per woman aged 40-49. This alternative is free of the right-censoring present in our measure (many younger women will not have completed their fertility when surveyed). However, it is also likely that fertility patterns will change across the generations, as socioeconomic conditions change, and in many of our countries fertility rates are high among teenage girls. In this case, restricting the fertility measurement to women past childbearing age will give us out-of-date figures with a substantial measurement error.

each country is correlated with a range of independent social and economic characteristics. With exclusion restrictions on the way in which these characteristics affect development outcomes, it is possible to measure some of the interactions between the outcomes. With further restrictions, it is possible to measure the impact of aid on each outcome. Appendix 2 provides some detail about the structure of the fitted model; the discussion that follows is a non-technical summary of this model.

Table 2: Illustrative statistics for Burkina Faso

	Q1	*Q2*	*Q3*	*Q4*	*Q5*
Electricity %	0	0	0	0	30
Piped water %	0	0	1	4	55
Using 'bush latrine' %	100	100	99	70	12
Live births per woman	7.2	6.9	6.8	7.0	4.5
Under-five mortality %	24	25	22	23	16
Primary education %	3	4	5	9	43

Source: Fielding et al. (2005).

Table 3: Illustrative statistics for Paraguay

	Q1	*Q2*	*Q3*	*Q4*	*Q5*
Electricity %	1	10	37	96	100
Piped water %	0	2	8	45	91
Using 'bush latrine' %	2	2	1	0	0
Live births per woman	7.9	6.3	4.3	3.9	2.7
Under-five mortality %	6	5	6	4	2
Primary education %	48	71	71	83	92

Source: Fielding et al. (2005).

A key part of the model is its identifying restrictions. Of the exogenous country characteristics that we allow for in our model of development, some might impact on all of our indicators. Among these characteristics are indicators of the countries' colonial affiliation, a measure of ethnolinguistic fractionalization,[8] and a dummy for countries in Africa. However, there are some restrictions that we can plausibly impose of the effects of other exogenous variables. These restrictions, summarised in Table 4, are as follows. Firstly, ethnolinguistic fractionalization and some of the geographical characteristics are unlikely to have a direct impact on anything other than material resources (measured by the assets index and sanitation) through an effect on factor productivity. These characteristics are country size and the value of the country's natural resource wealth.

8 This measures the probability of two randomly selected individuals in a country speaking different native languages. High fractionalization might be associated with lower social cohesion, damaging development along many dimensions.

Table 4: Model structure

Control variables	Appearing in the equations for				
dummy = 1 if in Africa	assets	sanitation	education	fertility	health
dummy = 1 if colonized by Britain	assets	sanitation	education	fertility	health
dummy = 1 if colonized by France	assets	sanitation	education	fertility	health
ethnolinguistic fractionalization index	assets	sanitation			
log country surface area	assets	sanitation			
log natural resource capital value	assets	sanitation			
dummy = 1 if country has coastline	assets	sanitation			health
fraction of the population Christian			education	fertility	
fraction of the population Muslim			education	fertility	
temperature (in 0.1°c)					health
temperature squared					health
fraction of pop. at risk from Malaria					health

Source: Fielding et al. (2005).

Similarly, other geographical characteristics are unlikely to have a direct impact on anything other than health. These characteristics are temperature[9,10] and the fraction of the population living in areas at risk of malarial infection. Whether a country has a coastline might affect health and wealth, but it is unlikely to affect education or fertility directly, and so it can be excluded from the equations for these two indicators. These restrictions together allow us to identify the effects of material assets, sanitation and health in each of the other four equations, except that the effects of assets on sanitation and of sanitation on assets are unidentified. The effects of fertility and education in the assets, sanitation and health equations are identified by assuming that religious adherence, as captured by the fraction of the population adhering to Christianity or Islam, has no direct effect on assets and health.[11] However, it might affect attitudes towards contraception or the value of education (especially female education), and so have a role in determining fertility and schooling. The other effects we do not attempt to identify—because of an absence of any obvious instrument—are of fertility in the education equation and of education in the fertility equation.

9 Temperature might affect the value of agricultural land and so factor productivity and material wealth, but we are already using natural resource wealth to control for the value of natural resources in the assets equation.

10 Pitt and Sigle (1997) show that climatic shocks (specifically, shocks to rainfall) have a permanent impact on birth rates in rural Senegalese households. Their interpretation of this result is that a shock to rainfall represents a shock to permanent income. In this case, having conditioned fertility on household assets, we do not need a climate variable in our fertility equation.

11 We rely on the assumption that religious affiliation will affect health only through its impact on education and fertility, and not in any other way.

The exclusion restriction that is used to identify the effect of aid on all the development indicators is that the dollar value of aid per capita (and no other variable in the model) depends on the country's past ability to absorb development assistance. This is measured by the past ratio of aid actually disbursed to aid nominally committed to a country.

In the following tables we summarise the results presented in Fielding et al. (2005) when child mortality as a measure of health and access to piped water as a measure of sanitation. In interpreting the results, two factors must be born in mind. First, the link between two development indicators, on average, can be positive or negative. Positive links will arise because human capacity in one dimension reinforces human capacity in another dimension. For example, well-educated people might be more economically productive, and therefore wealthier; moreover, wealthier people might have more time or money to spend on education.[12] Negative links will arise when people have to make a choice about where to commit time or money. More spent on schooling might mean less spent on, for example, sanitation. (In the case of positive feedback, aid devoted to one development outcome will also benefit others indirectly. In the case of negative feedback, aid will be beneficial to the extent that it relaxes the household's resource constraint.) We need not speculate about whether the positive or negative effect dominates for any given pair of development indicators: appropriate statistical analysis will reveal which is greater on average, or whether the two more or less cancel each other out. It turns out with our data that positive feedback effects dominate more often than negative ones, on average. For example, there are mutually reinforcing positive links between material wellbeing and education, between material wellbeing and lower child mortality, and between education and lower mortality. Nevertheless, there are a few negative links, in particular between education and sanitation.

Second, we ought to distinguish between the *direct* effect of aid, on average, and the 'equilibrium' effect. Imagine a 10 per cent increase in aid in a particular country. This may have several direct effects: improved sanitation, more education, lower child mortality, and so on. But this is not the end of the story: changes in one development outcome will then have knock-on effects on the others, on average. So the final effect of aid on development—the equilibrium effect—might be rather different from its direct effect.

In interpreting our fitted model, we should remember that the results are conditional on the historical pattern of aid expenditure. The results show the impact of aid as it has typically been used in recent years. Our model is based on an aggregate measure of aid to each country, and we do not make use of aid figures disaggregated according to the type of development project for which they are intended. It is true that there is some

[12] Some of these effects may occur with a substantial lag. With a cross-sectional dataset we do not have the opportunity to explore the dynamics of the interactions between the different development indicators.

variation in the proportions of aid intended for specific purposes. For example, the proportion of the total aid budget intended for education and health projects does vary somewhat from one country to another, as illustrated in Table 5 (in neither case is the average aid allocation to these sectors that large). However, there is not necessarily a simple correlation between the fraction of aid intended for a certain development outcome and the outcome actually observed. On the one hand, aid to a certain sector may stimulate more local investment in that sector (Gramlich 1969): evidence for this 'flypaper theory' is discussed in Devarajan and Swaroop (1998). The magnitude of the flypaper effect may vary across sectors. On the other hand, aid is at least partially fungible (see for example Devarajan et al. 1998). That is, the aid to a particular sector leads to a reduction in local investment in the sector. Again, the magnitude of the effect may vary across sectors.

Table 5: Education/health project aid as a fraction of total aid, 1995-2004

	Education %	Health %		Education %	Health %		Education %	Health %
Bangladesh	11.7	4.5	Ghana	7.8	5.9	Nicaragua	3.9	4.2
Benin	13.3	5.3	Guatemala	9.6	10.0	Niger	9.3	4.6
Bolivia	5.5	4.1	Guinea	12.5	4.1	Nigeria	8.6	13.6
Brazil	8.6	2.8	Haiti	9.4	9.7	Pakistan	3.0	2.6
Burkina Faso	11.4	4.6	India	7.4	6.9	Paraguay	6.6	3.7
Cambodia	7.9	8.1	Indonesia	5.8	2.5	Peru	3.2	4.1
Cameroon	11.3	2.1	Jordan	4.5	1.7	Philippines	4.5	2.3
C.A.R.	11.2	7.3	Kenya	6.7	9.7	Rwanda	6.0	6.3
Chad	11.0	7.9	Madagascar	8.2	3.4	S. Africa	17.7	5.5
Colombia	3.7	1.3	Malawi	13.0	9.0	Tanzania	7.0	9.2
Comoros	29.6	9.7	Mali	15.6	3.8	Togo	18.5	4.1
Cote d'Ivoire	7.1	2.8	Mauritania	12.0	2.9	Uganda	10.7	9.0
Dom. Rep.	8.1	8.7	Morocco	23.7	1.7	Viet Nam	5.0	2.6
Egypt	5.2	1.8	Mozambique	5.9	6.4	Yemen	9.6	4.0
Ethiopia	8.3	5.9	Namibia	16.9	4.3	Zambia	11.3	9.3
Gabon	16.9	2.5	Nepal	12.4	5.9	Zimbabwe	5.9	6.2
mean	*9.9*	*5.4*	*std. dev.*	*5.3*	*2.9*			

Source: Fielding et al. (2005).

What does the statistical analysis actually show? First, we will summarise the direct and equilibrium effects of aid (on average), without saying anything about the sizes of the different effects. Then, in order to illustrate the magnitude of the impact of aid, we will again refer to two examples drawn from our sample: Burkina Faso and Paraguay. The direct effects of aid (on average) on our five development outcomes are in Table 6. In indicating the direct effects, it is important to distinguish between those that are 'statistically significant' and those that are not. Roughly, this is a distinction between,

on the one hand, those characteristics of our data that are unlikely to have appeared at random, and on the other, those that could well be a 'fluke' telling us nothing about the likely effect of aid in countries and time periods outside our data.

Table 6: Direct effects of aid on the development indicators

Assets	positive and statistically significant
Sanitation	positive and statistically significant
Fertility	positive and statistically significant
Child mortality	negative (more aid reduces mortality) and statistically significant
Schooling	statistically insignificant (small but positive on average)

Source: Fielding et al. (2005).

Note that the direct effect of aid on fertility is positive. On average, the income stream that the aid represents encourages people to have more children. The equilibrium effects of aid are reported in Table 7. Here, it is important to remember that the effects of aid will vary across countries and across asset quintiles. How effective aid is depends on what level of development the households start off at.

Table 7: Equilibrium effects of aid

Assets	always positive
Sanitation	always positive
Fertility	mostly negative (that is, more aid reduces fertility)
Child mortality	always negative (that is, more aid reduces mortality)
Schooling	almost always positive

Source: Fielding et al. (2005).

Mostly, the direct effects of aid reinforce each other. Note that the equilibrium effect of aid on schooling is positive, even though the direct effect is small and statistically insignificant. This is because schooling responds positively to improvements in assets and child mortality. Note also that the equilibrium effect on fertility is mostly the reverse of its direct effect. The main reason for this seems to be that reductions in child mortality following an increase in aid reduce the number of births needed to achieve a family of a certain size.

Tables 8 and 9 illustrate typical predicted equilibrium effects in our sample of countries. The numbers show, in percentage terms, the equilibrium effects of a doubling aid on each development outcome.[13] In both Paraguay and Burkina Faso (as elsewhere), aid can be expected to improve the quality of life along several dimensions. However, it can be seen that there is some variation in the size of the effects between outcomes, between countries and between quintiles. Although there is a substantial general improvement in

[13] In interpreting these figures, it is worth noting that the mean sample value of our aid variables is 0.103; the corresponding standard deviation is 0.080.

the quality of life with an increase in aid, the effects on child mortality are typically much larger than other effects.

Table 8: Predicted growth, Burkina Faso

	Q1%	*Q2%*	*Q3%*	*Q4%*	*Q5%*
Assets increase	1.0	1.6	2.5	3.5	10.1
Sanitation increase	0.4	2.0	5.6	8.0	26.5
Fertility reduction	-3.6	-2.5	-1.0	0.8	11.6
Under-five mortality reduction	7.6	9.7	3.1	6.6	37.6
Primary education increase	1.5	2.0	2.5	3.5	7.5

Source: Fielding et al. (2005).

Table 9: Predicted growth, Paraguay

	Q1%	*Q2%*	*Q3%*	*Q4%*	*Q5%*
Assets increase	9.4	9.5	7.6	4.5	1.7
Sanitation increase	27.6	25.7	27.4	16.6	2.3
Fertility reduction	13.2	14.0	4.2	1.5	-3.0
Under-five mortality reduction	34.6	40.4	27.0	21.6	8.9
Primary education increase	6.3	6.4	3.4	1.3	0.9

Source: Fielding et al. (2005).

4 Conclusions

The results thus summarized show a straightforwardly positive effect of aid on development outcomes. This contrasts with an existing literature in which there are mixed results about the impact of aid on per capita GDP. One reason for this contrast may be that the results above focus on the impact of aid on human development, and how aid might promote investment in human capital. By contrast, existing studies implicitly model the impact of aid on labour productivity,[14] which will depend to a much greater degree on the extent to which aid promotes investment in physical capital. Moreover, any beneficial impact of aid on labour productivity could be offset by a Dutch Disease effect, as the inflow of foreign currency leads to a real exchange rate appreciation and a consequent reduction in export competitiveness.

The beneficial effects of aid are partly a consequence of positive interactions between different aspects of human development. For example, while higher levels of aid do not appear to be directly associated with a substantial improvement in schooling, they are associated with much better health, and there are strong positive interactions between health and schooling. Aid appears to be important in improving health outcomes,

[14] If the ratio of workers to non-workers in a population is constant, per capita GDP will be perfectly correlated with GDP per worker.

despite the fact that a relatively small fraction of aid budgets (about 5 per cent on average) is hypothecated to health expenditure. One potential explanation for this, meriting further research, is that there are relatively low fungibility and/or relatively large flypaper effects with aid to health.

It may well be the case that the effectiveness of aid in improving labour productivity does depend to a large degree on the effectiveness of domestic political institutions and macroeconomic policy. Governments need to manage the potential downsides of aid, such as Dutch Disease. Statistical analysis of the effect of institutions on development produces ambiguous results, because it is difficult to find reasonable exclusion restrictions to identify the effect of institutions. Nevertheless, there is a substantial body of evidence to suggest that institutions do matter for aid directed at industry. The Dutch Disease effect can be offset by good macroeconomic policy to promote competitiveness. These comments might apply to a much lesser degree, or not at all, when we look at the impact of aid on human capital and human development. This means that while it might make sense to restrict aid designed to promote productivity to countries with good governance, this argument does not apply when aid is designed to achieve other objectives. There is no need for industrialized nations to stop aid aimed at the alleviation of household poverty. Even with poor political institutions, it is possible that this sort of aid can be delivered with some degree of efficiency, as shown in the results summarized in this study.

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Appendix 1

Table A1: Summary sample statistics for the development indicators

Means	Assets	Sanitation	Education	Fertility	Health
quintile 1	0.1595	0.0411	0.3075	6.0625	0.1781
quintile 2	0.2511	0.1054	0.4083	5.3417	0.1682
quintile 3	0.3379	0.1551	0.4974	4.8542	0.1556
quintile 4	0.4481	0.2820	0.6110	4.2646	0.1294
quintile 5	0.6534	0.5277	0.7851	3.2146	0.0876
Standard deviations	Assets	Sanitation	Education	Fertility	Health
quintile 1	0.1175	0.1322	0.2224	1.3731	0.0914
quintile 2	0.1610	0.2289	0.2592	1.4158	0.1013
quintile 3	0.2013	0.2711	0.2691	1.5492	0.1023
quintile 4	0.2250	0.3150	0.2580	1.5444	0.0929
quintile 5	0.1822	0.3109	0.1642	1.1897	0.0582

Source: Fielding et al. (2005).

Appendix 2: The structure of the fitted model

Our dataset includes 48 countries, and in each country we measure five development outcomes in five household quintiles. Three of the outcomes (assets, sanitation, schooling) are measured on the [0,1] interval, with a substantial number of observations close to zero or unity, so these three variables are modelled in Probit form. The other two (fertility, mortality) are modelled in log-linear form.[15] Let the j^{th} development indicator for the k^{th} quintile in the n^{th} country ($j = 5$, $k = 5$, $n = 48$) be denoted y_{jkn}. Then our regression equation for the j^{th} indicator is

$$y_{jkn} = F(\alpha_{jk} + \Sigma_{i \neq j}\, \beta_{ij} \cdot y_{ikn} + \Sigma_p\, \varphi_{jp} \cdot x_{np} + \theta_j \cdot \ln(aid_n)) + u_{jkn} \quad \text{(A1)}$$

for j = (*assets*, *sanitation*, *schooling*) and

$$\ln(y_{jkn}) = \alpha_{jk} + \Sigma_{i \neq j}\, \beta_{ij} \cdot y_{ikn} + \Sigma_p\, \varphi_{jp} \cdot x_{np} + \theta_j \cdot \ln(aid_n) + u_{jkn} \quad \text{(A2)}$$

for j = (*fertility*, *mortality*).

F(.) is the Normal cumulative density function. x_{np} is the value of the p^{th} exogenous conditioning variable (listed in Table 4) in the n^{th} country, and u_{jkn} is a residual. Greek letters indicate constant parameters to be estimated. Note that the intercepts of the regression equations vary across quintiles, but the slope coefficients do not. (With only 48 countries, we do not really have enough degrees of freedom for quintile-specific regression equations.) Our aid equation is:

$$\ln(aid_n) = \alpha_{AID} + \Sigma_p\, \varphi_{AID\,p} \cdot x_{np} + \theta_{AID} \cdot \ln(discom_n) + u_{AIDn} \quad \text{(A3)}$$

Table A2: Summary of the structure of the model

	Assets equation	Sanitation equation	Health equation
Natural resources	¶	¶	
Ethnolinguistic fractionalization	*	¶	
Size	*	**	
Coastline dummy	*	¶	**
Temperature			¶
Squared temperature			¶
Malaria			**
	schooling equation	fertility equation	
Christian population	**	**	
Muslim population	*	**	

Source: Fielding et al. (2005).

[15] Strictly speaking, mortality is also measured on a bounded interval, but no observation is anywhere near the upper or lower bound. The sample distributions of *fertility* and *mortality* are approximately log-normal.

Identification of the model is achieved through zero restrictions on the φ parameters, as indicated in Table 4. The model is a fitted by 3SLS, allowing for non-zero correlations between all of the u_{jkn}. The fitted model is over-identified, since the assets, sanitation and health equations between them incorporate six instruments; the fitted model passes an over-identifying restrictions test. Tests of the significance of individual instruments in each equation produce results as follows. One asterisk indicates significance at the 5 per cent level, two indicate significance at the 1 per cent level; a paragraph mark indicates insignificance at the 5 per cent level.

Omission of the insignificant instruments still leaves an over-identified model in which the regression coefficients are similar to those in the original model. Given these results, we are confident in the overall robustness of our identification structure.