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Breaking Up The Relationship

Dichotomous Effects of Positive and Negative Growth on the Income of the Poor

Moritz Poll[†]

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Abstract

Much influential research on the relation between economic growth and the income of the poor has relied on the unstated assumption that positive and negative growth rates are equivalent in their effect on the poor. The most notable paper based on this assumption is "Growth is Good for the Poor" by Dollar and Kraay (2002), which has established a one-to-one relationship between economic growth and the income growth of the poor implying that every part of society benefits in the same way from economic growth. The notion of growth benefiting the poor like all other parts of society quickly gained traction and remains influential to this day. This paper argues that a homogeneous effect of positive and negative growth rates is neither reconcilable with economic intuition nor supported by the authors' own data. A breakpoint between positive and negative growth rates is identified and shown to be both statistically and economically significant. The effect of positive growth is estimated to be around 0.75 % income growth for the poor for every 1 % economic growth, while the effect of negative growth is found to be as high as 1.6 %. A one-to-one relation could only be obtained by averaging these two effects. The bottom line is that the poor do not seem to profit from growth like everyone else – a one-to-one relationship does not exist.

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[†]Department of Economics, University of Oxford: moritz.poll@oxfordalumni.org

1 Introduction

"Growth is Good for the Poor", the title of David Dollar's and Aart Kraay's (2002) groundbreaking paper published by the World Bank has become conventional and undisputed wisdom in the field of Development Economics. Even introductory literature adopts claims such as:

> "Raising people out of poverty requires growth."
>
> – Perkins, Radelet, and Lindauer (2006, p. 166)

Both international, macroeconomic comparisons and country-specific case studies broadly foster this claim. The economic literature by now has turned to more specific questions regarding the effectiveness of growth (also in comparison to other policy measures) in alleviating poverty. While primal papers usually focused on regression analysis that gave results at the aggregate level, a new strand of literature has criticized this approach (Ravallion, 2008) and examined the growth-poverty alleviation relation on a single observation level (Donaldson, 2008; Danielson et al., 2001; Ravallion, 2004). They all, however, rely on the basic finding of Dollar and Kraay (2002) that economic growth and growth of the income of the poor are on average related one-to-one.

This paper is meant to build up on and scrutinize the findings of Dollar and Kraay (2002). Both the data and the employed-upon methodology leave room for discussion and improvement questioning the proposed unit elasticity of growth and income growth of the poor. In a nutshell, the authors disregard a both statistically and economically significant dichotomy between the effect of positive and negative economic growth on the income of the lowest quintile of a country's income distribution. As a consequence, they overestimate the beneficial effect of positive growth while underestimating the distinctly detrimental nature of below zero growth on the poor. Moreover, increasing growth rates structurally seems less beneficial for the poor in countries with positive growth rates than in those with consistently negative growth rates if poverty alleviation is the objective. It may be worthwhile to make explicit that this paper is not attempting to reject the general assertion of growth being good for the poor, but rather to relativize the universal validity and strength of the relationship while highlighting the detrimental effect of negative growth.

This paper sets out to answer the question whether there is a dichotomous effect of positive and negative growth on the income of the poor. Section 2 provides a literature review of the central source and the papers closely related to it. Section 3 presents the replication of the model and main findings of Dollar and Kraay (2002). Section 4 introduces a breakpoint at zero growth and shows its economic and statistical significance. Section 5 scrutinizes the findings with a number of robustness tests. Section 6 concludes with policy implications and recommendations for future research.

1 Literature Review

1.1 Dollar and Kraay (2002)

The central underlying source for this project is “Growth is Good for the Poor” by David Dollar and Aart Kraay (2002) of which a condensed summary will be provided in the following. Growth is defined as the average yearly growth rate of per capita income measured in 1985 Purchasing Power Parity adjusted USD over five years and income growth of the poor as the same construct for the lowest quintile of the country’s income distribution. The authors work in two different specifications: Log levels and growth rates. Based on a panel data set of 92 countries over four decades, they find (a) evidence of a unit elasticity between a country’s log income and the log income of the poor (log specification), that is for every 1 % additional income of the country, the poor are expected to gain proportionally by 1 %. Further, and more importantly, they find (b) evidence for a unit elasticity of economic growth of a country and the income growth of the lowest quintile of the society (growth rate specification), that is for every additional percentage point of a country’s income growth, the poor are expected to gain proportionally by 1 percentage point. Figures 2 and 3, replications of Figure 1 of Dollar and Kraay (2002), illustrate this relation in its most parsimonious specification. The estimated slope coefficients are not significantly different from 1.

The authors test their findings with specifications in which they include common determinants of growth like rule of law, openness to trade, development of the financial system, stabilization from high inflation and the reduction in government size to see whether these have significantly different effects on the poor than they do on the rest of society. Only the last two are found to have marginal significance. Finally, factors that are widely recognized as profiting the poor in particular are incorporated, namely primary educational attainment, social spending, agricultural productivity, and formal democratic institutions but none of these appears significant. Regional and income level specifications can explain some part of the differences but do not change the main results. In almost none of the tests can a slope of 1 be rejected, often due to amazingly high standard errors. A one-to-one relationship appears robust.

1.2 Policy Implications

Results like the above are strong pillars on which the World Bank, other international institutions and governments have based their strategy of poverty alleviation. Throughout the 1990s, poverty reduction centered fully on policies to increase the income of the poor, taking economic growth for granted and therefore disregarding policies to its promotion (Page, 2006). Especially the poorest countries in the world consequently failed on both accounts. Provided that most major indicators of welfare apart from income itself are positively related to growth and that the poor benefit as much as anyone else from growth as Dollar and Kraay (2002) suggest, the World Bank has strongly pushed

for reforms and policies promoting economic growth as a core instrument for achieving its central mission, the eradication of global poverty (World Bank, 2002). Should the foundation on which these policy implications rest prove fragile, i.e. the impact of growth on the poor be less than proportional, the World Bank's shift to growth promotion would likely have been too strong and should be adjusted back to more direct measures of poverty reduction or at the least growth promotion through channels such as education or other types of public investment that benefit the poor immediately.

1.3 Reactions to Dollar and Kraay (2002)

Gundlach, Navarro de Pablo, and Weisert (2004) review Dollar and Kraay (2002) casting doubt on a specification in which human capital comes into play via education. They find that adjusting the education data by a quality measure does turn education significant in their regression analysis – an assertion that the original paper rejected.

A more serious threat to the Dollar and Kraay (2002) findings – and to this project – may stem from a paper by Lubker, Smith, and Weeks (2002). Their critique is multilateral and fundamental in nature. Firstly, they criticize the theoretical framework of running a regression with the average of some subgroup of a population (income of the poor) as the dependent variable on the population average (income of the entire country), which by definition has to be close to 1 if the population is reasonably homogeneous. This, however, is not a valid argument, because the heterogeneity, i.e. the income inequality in a country, is likely to be considerable and of key interest in this context. It is precisely because intuition might suggest otherwise that testing a one-to-one relationship represents an interesting question. They continue claiming that when expecting a value of 1 from theoretical reasoning, neither is the obtained unit elasticity a notable finding, nor can a causal relation from economic growth to income growth of the lowest quintile (i.e. poverty eradication) be sensibly built upon such a regression. This argument would have a certain merit, if the Dollar and Kraay (2002) paper presented its findings as a causal relationship. Admittedly – and understandably – the authors do link their findings to growth promoting policies of the World Bank, giving it a causal flavor and thereby trying to justify growth promotion as a core of the poverty reduction toolbox. But Dollar and Kraay (2002) do not claim to set up a framework of causal relation between the two growth rates. They want to demonstrate by means of a correlation whether growth on average tends to flow more, less or just proportionally in the pockets of the lowest quintile, for which the chosen method (although not uniquely) is well suited. Secondly, the correctness and consistency of the employed data is questioned. More precisely, Dollar and Kraay (2002) retrieve data from different sources and have to adjust it for the purpose of comparability. The adjustments are criticized for introducing flaws in the data. Additionally, specific countries are argued not to belong into the data set for being too far developed or too chaotic in terms of their data provision and policy. Thirdly, the paper is questioned for its specification tests including different policies. The criticism ranges from the employed wording to the more technical choice of a system framework for some of the misspecification tests, and is

beyond the scope of this paper. Finally, in line with this project, World Bank and IMF are criticized for placing growth promotion too central-stage for poverty reduction even if the unit elasticity was beyond doubt, as this would still leave the income distribution and thus inequality unaffected.

Donaldson (2008) and his students interpret outliers given a one-to-one relation as cases in which other factors than growth alleviate or exacerbate poverty. They find that most alternative explanations are not new to economic debate but have substantially lost influence, such as redistributive policies, social safety nets or stability enhancing measures in the positive cases and the renunciation of progressive redistribution, corruption, debt, inflation or violent conflicts in the negative cases. The paper also points at some weaknesses in the underlying data and criticizes a blind reliance on growth.

In a later project together with Tatjana Kleineberg, the original work is updated with a vast amount of recent, more consistent data and applied to the lowest 40 % of the population, following the World Bank's policy to promote "shared prosperity", i.e. the income growth of the lowest two quintiles. Some policy variables are adjusted in the spirit of the above critique. The title already gives the main message away: "Growth Still is Good for the Poor" (Dollar, Kleineberg, & Kraay, 2013). A regression line is drawn through a much denser and more uniform scatter and now turns out even closer to a 45 line. The combination of the two lowest quintiles has averaged out the outliers. This of course does not imply that the update remedies the above-mentioned concerns. When increasing the sample in question from 20 % to 40 % of the population, it is just natural that the correlation and fit both approach unity. In accordance, the World Bank World Development Report 2014 is all in the spirit of shared prosperity, illustrating the shift of the World Bank's focus towards the lowest two quintiles. The findings of Dollar et al. (2013) do not reduce the justification of this research paper as they concern a fundamentally different segment of the population.

1.4 Remaining Criticism of Dollar and Kraay (2002)

Dollar and Kraay (2002) seem to have shown that there is a one-to-one relation between a country's income and that of the poor in the log level and between economic growth and income growth of the lowest quintile in the growth rate specification. At one point, the authors even test whether the slope coefficient might differ for positive and negative growth. The test they employ, however, cannot detect the dichotomy. In the last row of their Table 4, they introduce an interaction term of the log level income with a dummy for negative growth. This is inappropriate for two reasons. First, the underlying data is in log levels, meaning that the regression would only yield differing slopes if the growth pattern coincided with differences in the log levels. Second, they do not allow for a different intercept. Forcing these lines to go through the same intercept when the data cloud ranges roughly between 6 and 10 in the horizontal dimension and 4 to 9 in vertical dimension, renders differing slopes almost impossible. Figure 2 can serve as an illustration[1]. The growth rate specification is not tested.

[1] It turns out that the first is the more problematic mistake. An adjustment for the latter did not reveal a breakpoint in the log-level data.

The criticism on the Dollar and Kraay (2002) data should not be taken lightly. Donaldson (2008) identifies two data points possibly subject to measurement error of which one is actually used in the data set but does not change the results obtained in the original work or here when omitted. Lubker et al. (2002) argue that the highly industrialized countries should not be taken into consideration for the examination of the posed research question. However, neither is the level of income found to be significant for the effect of growth on the income of the poor in Dollar and Kraay (2002), nor can a relevant pattern in this context be identified from visual examination of Figure 4[2]. Whether or not income growth reaches the poor does not seem to depend on whether an industrial or a developing country is considered. Although the data criticism cannot be simply dismissed, the infringements seem neither pernicious nor systematic, so the data set appears reasonably reliable and suitable. More importantly, when using the original data set, the substantial doubt cast on the results by Dollar and Kraay (2002) emerges from their own data and not from a different source and can thus – if found robust – claim the same authority.

2 Replication of Dollar and Kraay (2002)

In a first step, the basic results of the study are replicated[3]. Dollar and Kraay (2002) run two fundamentally different specifications, the first (1) in logs and the second (2)[4] in growth rates:

$$\ln(Y_{ct}^{p}) = a_0 + a_1 \ln(Y_{ct}) + m_c + e_{ct} \quad (1)$$

$$D\ln(Y_{ct}^{p}) = b_0 + b_1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (2)$$

where $\ln(Y_{ct}^{p})$ is the log income of the lowest quintile of the population of country c at time t, $\ln(Y_{ct})$ that of the country c at time t as a whole, $D\ln(Y_{ct}^{p})$ is the growth of the income of the lowest quintile of the population of country c at time t, $D\ln(Y_{ct})$ that of the country c at time t as a whole, and $m_c + e_{ct}$ and $\mu_c + e_{ct}$ denote the composite cross-sectional and time-dimensional error terms respectively. Table 1 provides an overview. Both specifications are replicated in turns.

The obtained results for the log specification can be found in the third column of Table 2 and the associated Figure 2 and compared to the original results in the first column. The second column of the table provides a full sample replication, whereas the authors restrict the observations to only those used after differencing for the growth rate model. The replication of the growth rate specification is

[2] It can, however, be inferred that the especially stark negative growth observations are mostly former Soviet countries as no other region has experienced such prolonged negative growth periods. Other low-income countries, however, can be found in any part of the scatter, so a dependence on development status or initial income, as already examined and rejected by Dollar and Kraay (2002) is disregarded.

[3] The dataset of Dollar and Kraay (2002) is freely available under http://go.worldbank.org/H9DUJ3F3K0 and the authors give a very detailed and mostly transparent overview of their work.

[4] Specication (4) in Dollar and Kraay (2002). Originally – for theoretical reasons – without an intercept. The authors do not actually test the intercept's insignificance but simply assume it away.

shown in columns (b) and (c) of Table 3 and the associated Figure 3. The results do not perfectly match those of Table 3 and the associated Figure 1 of Dollar and Kraay (2002). The reason is that the authors only use 269 of the available 285 data points and silently omit the other 16. While the motivation for this can only be speculated about, the essential result is barely affected when running the regression over the full range of data. Using the model of a simple linear regression, the result of the authors is therefore confirmed.

Although both equations (1) and (2) have a certain "growth rate interpretation", it is pivotal to note the difference between them. This is fundamental in understanding why the dichotomous effect introduced in section 4 is a phenomenon observed in the growth rate specification only. The coefficient a_1 in equation (1) can be interpreted as indicating that for every one percent higher income, the poor tend to have on average a_1 percent more income. In equation (2), however, an additional percentage point in the growth rate is associated on average with b_1 additional percentage points in the growth rate of the income of the poor. Crucially, the former remains a level effect while the latter is a growth rate elasticity. This explains why the introduction of a dummy for negative growth rates in the original paper could not possibly detect a break and indicates why the whole log framework as such is inappropriate for answering a question related to growth rate elasticities.

3 Dichotomous Income Effects

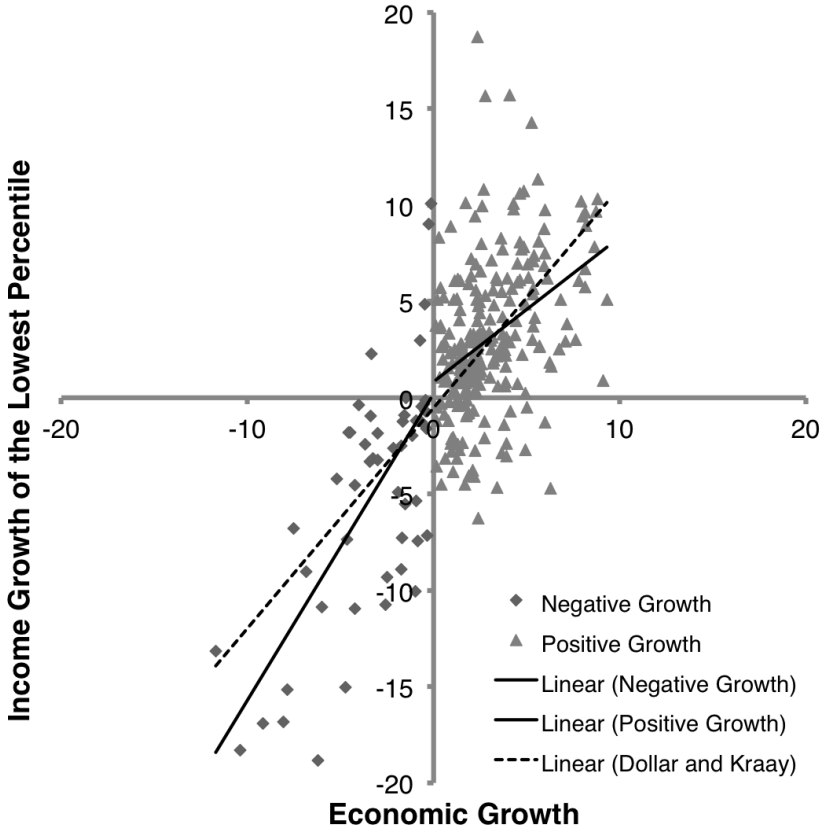
In this section, a breakpoint between positive and negative growth rates will be introduced in order to test for a dichotomous effect on the income of the poor. Intuitively, the poor are the most vulnerable to negative economic growth and likely to lose most from it. They are the least educated, the first to be limited by budget and credit constraints in times of unemployment, the least likely to be able to shift capital abroad, and the first to be hit by social spending cuts. In times of positive growth they can be assumed to have less access to capital markets, low mobility to reach emerging industrial hubs, and lack the flexibility to acquire new skills demanded in the economy. Their benefits might be smaller than those of richer people. Accordingly, the effect of positive and negative growth rates on the income growth of the poor may likely be different. To this end, a dummy with value 1 for negative growth rates and the value 0 for positive growth rates, and an interaction term for differing slopes are introduced. The resulting model will be run in three equivalent specifications to examine different parameters. Equivalence is derived in the appendix. The results can be found in column (d) of Table 3:

$$D\ln(Y_{ct}^{p}) = b_0 + b_1(1-1)D\ln(Y_{ct}) + b_2 1 + b_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \tag{3a}$$

$$D\ln(Y_{ct}^{p}) = g_0 + g_1 D\ln(Y_{ct}) + g_2 1 + g_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \tag{3b}$$

$$D\ln(Y_{ct}^{p}) - D\ln(Y_{ct}) = d_0 + d_1(1-1)D\ln(Y_{ct}) + d_2 1 + d_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \tag{3c}$$

Figure 1: Dichotomous Income Effects vs. the Linear Relationship of Dollar and Kraay (2002)



Note: Every dot is a five-year average of the growth rate of the country in question. Countries can appear multiple times in the graph.

where $1 = 1(\text{Dln}(Y_{ct}) < 0)$ is an indicator function equal to 1 for below zero growth. In equation (3a), $b_1 = 0{:}75$ and $b_3 = 1{:}59$ are the two slopes of interest for the case of positive and negative growth respectively. Economically, these slopes are far off the original one-to-one relation. The poor can on average only capture about 0.75 % of every 1 % positive income growth of the country, while they loose disproportionately with about - 1.6 % for every - 1 % (negative) income growth of the country. The result further indicates that growth promotion is much more effective in countries with negative growth than it is in the much more common case of positive growth. The statistical significance of this finding is examined in the lower panel of Table 3. The second equation, the somewhat classical way of introducing dummy variables, can be used to test whether the coefficients g_2 and g_3 are jointly significant, i.e. testing the breakpoint against the original model by Dollar and Kraay (2002). The associated F test is presented in the second last row of Table 3 and is highly significant. The existence of a dichotomous income effect cannot be rejected. The last equation produces coefficients that can be tested for whether the original b_1 and b_3 are individually and jointly significantly different from 1 with the results in the last row of Table 3. The fact that they are, renders the conclusion of Dollar and Kraay (2002) that all quintiles of society share growth and profit equally from it implausible. Figure 1 contrasts the dichotomous income effect model with the original linear specification. It illustrates how the authors could obtain a one-to-one relationship by effectively averaging the two line segments.

4 Robustness

This section will ask a number of questions in order to check the model's robustness:

1. Are the findings robust to theoretical restrictions on the intercept?
2. Does the breakpoint lie exactly at zero economic growth?

5.1 Restrictions on the Intercept

Theoretical considerations might suggest that the intercepts of the two branches of the dichotomous income effect model coincide on the same point or should even be restricted to equal zero[5]. Graphically, it is clear that such restrictions will affect the slope. The issue is inquired in columns (e) and (f) of Table 3. Imposing $b_2 = 0$ turns results in the following specification:

$$D\ln(Y_{ct}^{p}) = b_0 + b_1(1-1)D\ln(Y_{ct}) + b_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (4)$$

This turns both slopes steeper but the dichotomy remains in place and both slopes are still significantly different from one.

The second restriction omits the intercept altogether, i.e. $b_0 = b_2 = 0$, thereby forcing both lines to pass through the intercept:

$$D\ln(Y_{ct}^{p}) = b_1(1-1)D\ln(Y_{ct}) + b_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (5)$$

The dichotomous income effect remains in place but the right side of the graph now has a slope that is insignificantly different from one. While the positive growth branch returns to a one-to-one relation, it should be noted that the above restriction is dubious as the intercept in earlier specifications has generally been significantly different from zero. It can be concluded that the dichotomous income effect is robust to restrictions on the intercept and that a one-to-one relationship requires assumptions that are not supported by the data.

5.2 Locus of the Breakpoint

Up to here, a breakpoint at zero economic growth has been assumed. Although this is intuitively appealing, it might not be supported by the data. A major challenge when addressing the exact locus of the breakpoint is the imbalance in the data. Only about 17.9 % of the data exhibit negative economic growth. As breakpoint detection requires a trimming of the data, the amount of data excluded from possible breakpoints should be chosen wisely. Columns (g) to (i) of Table 3 show the results for three

[5] Dollar and Kraay (2002) derive the latter theoretically but do not provide an actual test of significance of the intercept or the effect of its omission on the slope.

breakpoints different from 0 obtained through various fit optimizations. Columns (g) and (h) show open breaks with differing intercepts under 10 %[6] and 15 %[7] trimming respectively obtained by an Quandt-Andrews algorithm. Column (g) is a hockey stick break similar to column (e) and obtained by nonlinear fitting. The results confirm the dichotomous income effect model. The slope for above breakpoint growth is significantly smaller than 1 throughout. That for below breakpoint growth once requires 15 % significance to reject being equal to 1. The other tests for breakpoint significance strongly reject the original linear model by Dollar and Kraay (2002) as well.

5 Conclusion

This paper has shown that in contrast to the findings of Dollar and Kraay (2002), the relation between growth and the income of the poor is more complex than previously assumed and simplifying it to a linear one-to-one relation involves the danger of misguided policies for poverty reduction. It turns out that positive growth benefits the poor less than one-to-one while negative growth rates harm them significantly more. Improving the conditions of countries with structurally negative growth appears to be more promising, but only as long as success is certain. The above findings provide helpful insights to reconsider policy measures that risk ending in austerity and recession if harm for the poor ought to be prevented. At the same time, increasing economic growth in the more likely case of positive growth countries turns out significantly less effective than past research has suggested. As economic growth seems to benefit the poor less than proportionally, policies for poverty alleviation should be targeted more directly at the poor by making growth benefits more accessible through education or infrastructure projects or by a readjustment towards more redistributive policies like progressive taxation and stronger social safety nets.

Future research in this area should overcome the data limitations by updating, extending and harmonizing the data set but also repeat analyses like those of Donaldson (2008) given the dichotomous income effect model. Moreover, it should be investigated whether a breakpoint at zero growth indeed captures the full relation or whether some nonlinear, continuous function is better suited. Finally, the total benefits from growth are a zero-sum game. If the poor tend to earn less than one-to-one, some part of society must necessarily earn more. Analyzing this relation for other parts of the income distribution might shed new light on the extent to which different parts of society can benefit from growth and how growth promotion is and can be used to support one group or another more directly and effectively.

[6] The same breakpoint results for 5 % trimming.

[7] In which case the original breakpoint is trimmed away.

References

Danielson, A., et al. (2001). When do the Poor benefit from Growth, and why? Citeseer.

Dollar, D., Kleineberg, T., & Kraay, A. (2013). Growth Still Is Good For The Poor.

Dollar, D., & Kraay, A. (2002). Growth Is Good for the Poor. Journal of Economic Growth, 7(3), 195-225.

Donaldson, J. A. (2008). Growth Is Good for Whom, When, How? Economic Growth and Poverty Reduction in Exceptional Cases. World Development, 36(11), 2127-2143.

Gundlach, E., Navarro de Pablo, J., & Weisert, N. (2004). Education Is Good for the Poor: A Note on Dollar and Kraay. In A. Shorrocks & R. van der Hoeven (Eds.), Growth, Inequality, and Poverty: Prospects for Pro-Poor Economic Development (p. 92-106). UNU-WIDER Studies in Development Economics. Oxford and New York: Oxford University Press.

Lubker, M., Smith, G., & Weeks, J. (2002). Growth and the Poor: A Comment on Dollar and Kraay. Journal of International Development, 14(5), 555-571.

Page, J. (2006). Strategies for Pro-poor Growth: Pro-poor, Pro-growth or Both? Journal of African Economies, 15(4), 510-542.

Perkins, D., Radelet, S., & Lindauer, D. (2006). Economics of Development.

Ravallion, M. (2004). Pro-Poor Growth: A Primer.

Ravallion, M. (2008). Growth, Inequality and Poverty: Looking beyond Averages. In P. Collier & J. W. Gunning (Eds.), Globalization and poverty (p. 330-342). Elgar Reference Collection. Globalization of the World Economy series, vol. 19. Cheltenham, U.K. and Northampton, Mass.: Elgar.

World Bank. (2002). World Development Report 2002: Building Institutions for Markets. Oxford and New York: Oxford University Press for the World Bank.

World Bank. (2014). World Development Report 2014: Risk and Opportunity: Managing Risk for Development. Washington, D.C.: World Bank.

Appendix

A Derivations

A.1 Equivalence of equations

This section shows the equivalence of the following three equations:

$$D\ln(Y_{ct}^{p}) = b_0 + b_1(1-1)D\ln(Y_{ct}) + b_2 1 + b_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (A.1)$$

$$D\ln(Y_{ct}^{p}) = g_0 + g_1 D\ln(Y_{ct}) + g_2 1 + g_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (A.2)$$

$$D\ln(Y_{ct}^{p}) - D\ln(Y_{ct}) = d_0 + d_1(1-1)D\ln(Y_{ct}) + d_2 1 + d_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (A.3)$$

Starting from (A.1), equation (A.2) is derived as:

$$D\ln(Y_{ct}^{p}) = b_0 + b_1(1-1)D\ln(Y_{ct}) + b_2 1 + b_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (A.4)$$

$$D\ln(Y_{ct}^{p}) = b_0 + b_1 D\ln(Y_{ct}) + b_2 1 + (b_3 - b_1) 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (A.5)$$

By a similar transformation, (A.3) is derived as:

$$D\ln(Y_{ct}^{p}) = b_0 + b_1(1-1)D\ln(Y_{ct}) + b_2 1 + b_3 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (A.6)$$

$$D\ln(Y_{ct}^{p}) - D\ln(Y_{ct}) = b_0 + (b_1 - 1)(1-1)D\ln(Y_{ct}) + b_2 1 + (b_3 - 1) 1 D\ln(Y_{ct}) + \mu_c + e_{ct} \quad (A.7)$$

The following equivalences result:

$$b_0 = g_0 = d_0 \text{ and } b_2 = g_2 = d_2 \quad (A.8)$$

$$g_1 = b_1 \text{ and } d_1 = b_1 - 1 \quad (A.9)$$

$$g_3 = b_3 - b_1 \text{ and } d_3 = b_3 - 1 \quad (A.10)$$

B Data and Findings

B.1 Variable Setup

Table 1: Variable Setup

Name	Symbol	#	Definition
Log Income	$\ln(Y_{ct})$	377	Log per capita income, measured in 1985 Purchasing Power Parity adjusted USD over five years.
Log Income of the Poor	$\ln(Y_{ct}^{P})$	377	Log per capita income of the lowest quintile of the country's income distribution, measured in 1985 Purchasing Power Parity adjusted USD over five years.
Economic Growth	$D\ln(Y_{ct})$	285	The average yearly growth rate of per capita income, measured in 1985 Purchasing Power Parity adjusted USD over five years.
Income Growth of the Poor	$D\ln(Y_{ct}^{P})$	285	The average yearly growth rate of per capita income of the lowest quintile of the country's income distribution, measured in 1985 Purchasing Power Parity adjusted USD over five years.
Indicator of Negative Growth	1	285	An indicator function $1 = 1(D\ln(Y_{ct}) < 0)$ equal to one if economic growth is negative.

Note: The panel spreads 92 countries over four decades of data. Missing values reduce the Log level data to a total of 377 observations and differencing in order to obtain growth rates reduces the sample to 285 observations as opposed to the 269 employed in Dollar and Kraay (2002). The remaining discrepancy remains unresolved as 16 observations are silently omitted in the paper.

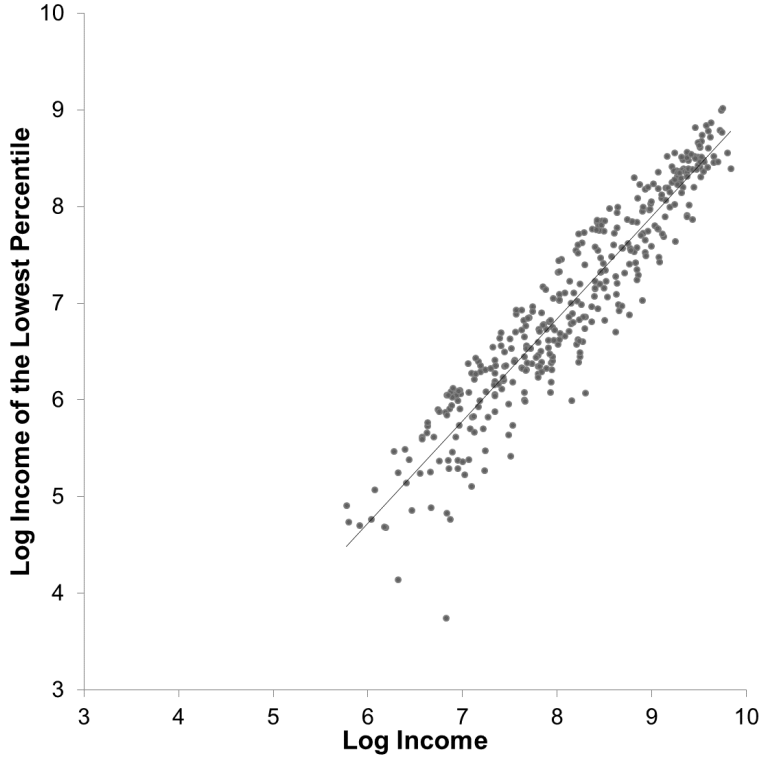
B.2 Replication and Findings

Table 2: Log Level Model: Original and Replication

Dependent Variable: Log Income of the Poor			
	Dollar & Kraay	Full Sample	Restricted Sample
Equation	(1)	(1)	(1)
Constant	-1.762	-1.630	-1.714
	(0.210)	(0.242)	(0.287)
Log Income	1.072	1.058	1.067
	(0.025)	(0.029)	(0.033)
Regression Statistics and Tests			
R^2	-	0.891	0.891
Adjusted R^2	-	0.891	0.890
Observations	269	377	285

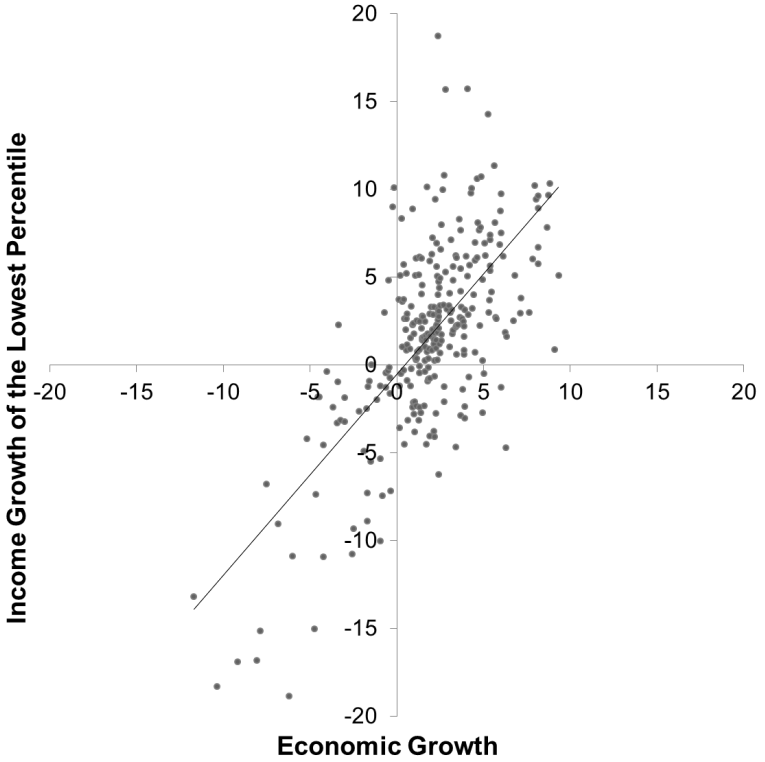
Note: Standard Errors are clustered by country to correct for cross-sectional heteroskedasticity. The number of observations in the last column is reduced to those that remained after differencing for the growth rate model.

Figure 2: Replication of Log Level Model of Dollar and Kraay (2002)



Note: Every dot is a five-year average of the log income of the country in question. Countries can appear multiple times in the graph.

Figure 3: Replication of Growth Rate Model of Dollar and Kraay (2002)



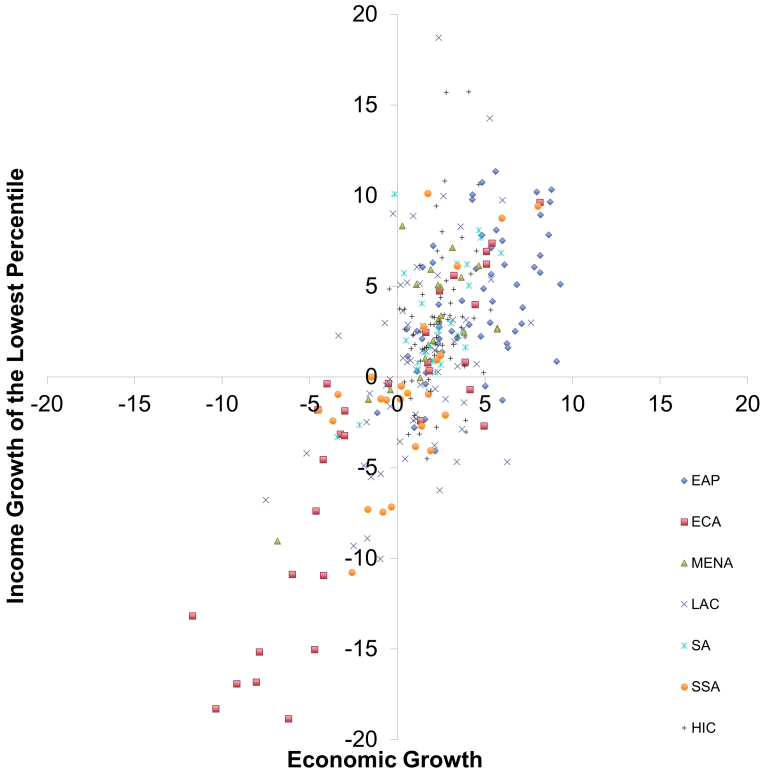
Note: Every dot is a five-year average of the growth rate of the country in question. Countries can appear multiple times in the graph.

Table 3: Growth Rate Model: Original, Replication and Dichotomous Income Effects

Dependent Variable: Income Growth of the Poor									
	Dollar & Kraay	Replication		Dichotomous Income Effects					
Column	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Equation	(2)	(2)	(2)	(3)	(4)	(5)	(3)	(4)	(4)
Breakpoint	-	-	-	0 %	0 %	0 %	-0.83 %	-0.35 %	0.29 %
Constant	-	-	-0.522	0.832	0.690	-	0.947	1.073	0.687
			(0.267)	(0.362)	(0.319)		(0.346)	(0.364)	(0.319)
Indicator (Growth < 0)	-	-	-	-0.620	-	-	-2.290	-1.785	-
				(1.106)			(1.212)	(0.914)	-
Economic Growth	0.983	1.075	1.145	-	-	-	-	-	-
	(0.076)	(0.066)	(0.084)				-	-	-
Positive Growth	-	-	-	0.751	0.782	0.937	0.725	0.695	0.782
				(0.101)	(0.092)	(0.056)	(0.098)	(0.102)	(0.092)
Negative Growth	-	-	-	1.591	1.676	1.554	1.330	1.432	1.677
				(0.219)	(0.157)	(0.143)	(0.227)	(0.191)	(0.157)
Regression Statistics and Tests									
R^2	-	0.512	0.472	0.504	0.503	0.541	0.511	0.510	0.503
Adjusted R^2	-	0.510	0.470	0.498	0.499	0.538	0.505	0.504	0.500
Observations	269	285	285	234 & 51	234 & 51	234 & 51	245 & 40	236 & 49	228 & 57
$P(b_1 = 1)$	0.823	0.261	0.088	-	-	-	-	-	-
$P(b_1 = 1)$	-	-	-	0.015	0.020	0.258	0.006	0.004	0.020
$P(b_3 = 1)$	-	-	-	0.008	0.000	0.000	0.149	0.026	0.000
$P(b_1 = b_3)$	-	-	-	0.000	0.000	0.000	0.010	0.001	0.000
$P(g_2 = g_3 = 0)$	-	-	-	F=10.632	t=4.470	t=4.188	F=11.693	F=11.983	t=4.484
				P=0.000	P=0.000	P=0.000	P=0.000	P=0.000	P=0.000
$P(b_1 = b_3 = 1)$	-	-	-	F=7.966	F=10.215	F=8.772	F=5.888	F=7.934	F=10.277
				P=0.001	P=0.000	P=0.000	P=0.004	P=0.001	P=0.000

Note: Standard Errors are clustered by country to correct for cross-sectional heteroskedasticity. Column (a) reports the original results. Column (b) replicates the third column of Table 3 of the original paper while column (c) replicates the specification in Figure 1. Column (d) introduces a breakpoint. Columns (e) and (f) test for restrictions on the intercept. Columns (g) to (i) inquire the exact locus of the breakpoint.

Figure 4: Geographic Decomposition



Note: This graph shows the geographic decomposition of the data set. The most notable pattern consists of most growth disaster countries being former Soviet states. Every dot is a five-year average of the growth rate of the country in question. Countries can appear multiple times in the graph.