

Trade Causes Growth in Sub-Saharan Africa

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March 2012



Abstract

In the 1990s the mainstream consensus was that trade causes growth. Subsequent research shed doubt on the consensus view, as evidence suggested that the identification of the effect of trade on growth was problematic in the existing literature. This paper contributes to this debate by focusing on growth in Sub-Saharan Africa. It estimates the effect of openness to international trade on economic growth with panel data. Employing instrumental variables techniques that correct

for endogeneity bias, the empirical evidence suggests that within-country variations in trade openness cause economic growth: a 1 percentage point increase in the ratio of trade over gross domestic product is associated with a short-run increase in growth of approximately 0.5 percent per year; the long-run effect is larger, reaching about 0.8 percent after ten years. These results are robust to controlling for country and time fixed effects as well as political institutions.

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Trade Causes Growth in Sub-Saharan Africa

by

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Key words: Trade, Growth, Africa

JEL codes: E2, F1

Sector Board : EPOL

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1. Introduction

Frankel and Romer (1999) showed that exogenous cross-country variations in international trade were positively correlated with GDP per capita across countries. Their identification strategy relied on the gravity model of trade, whereby bilateral geographic distances between trading partners was used as an exogenous instrument for each country's volume of trade. However, subsequent research argued that these geographic instruments were closely correlated with countries' historical experiences during colonial times, which in turn help explain the international differences in governance and institutions (Acemoglu et al., 2001). Rodrik et al. (2004) thus argued, and showed empirically, that "institutions rule": once the institutional channel is controlled for, international trade appears to have no impact on GDP per capita across countries. Furthermore, Rodriguez and Rodrik (2001) also had shed doubts on highly cited papers that argued that international trade is associated with higher growth rates of total factor productivity or GDP per capita. Rodriguez and Rodrik argued that this influential literature suffered from fatal flaws, including the endogeneity of international trade and other specification and econometric problems.¹

Moreover, doubts are further justified by biases arising from omitted variables in cross-sectional growth regressions.² Even the econometric estimates in the seminal papers by Acemoglu et al. (2001) and Rodrik et al. (2004) may be suspect. What is needed to advance the debate on the growth effects of openness to international trade is an estimation strategy that controls for time-invariant country characteristics. We exploit, using panel data, within-country variations in countries' trade openness and GDP per capita. By exploiting these within-country variations, we are able to control for country fixed effects, which account for any time-invariant country characteristics that affect both international trade and economic growth. The panel fixed effects approach is, therefore, an important step forward to uncovering causal effects of trade openness on

1 For some further readings see, for example, Edwards (1993), Vamvakidis (2002), Alcalá and Ciccone (2004), or Wacziarg and Welch (2008). It is also noteworthy that in the past decade there have been a number of papers that documented, using firm-level data, the effects of exporting on firms' productivity and employment. For some examples, see Van Biesebroeck (2005), Verhoogen (2008), Fernandez (2007), or Lileeva and Trefler (2010).

2 See, for example, Levine and Renelt (1992) or Ciccone and Jarocinsky (2011).

economic growth.

To uncover causal effects of openness on economic growth, we, of course, also need to tackle endogeneity biases that arise from reverse causality and within-country omitted variables. To do so, we deploy two complementary instrumental variables (IV) strategies. The first IV strategy uses rainfall as an instrument for GDP per capita in Sub-Saharan Africa (SSA) to estimate the response of trade openness to within-country variations in GDP per capita. This IV strategy builds on prior literature that has established a robust effect of rainfall on SSA countries' GDP per capita.³ The IV strategy enables us to obtain useful information on the extent to which international trade is itself a function of SSA countries' GDP per capita. It enables us, furthermore, to compute a residual trade openness variable that, by construction, is exogenous to within-country variations in GDP per capita. In our first IV strategy, we use this residual trade openness variable as an instrument to estimate the within-country growth effect of openness to international trade.

The second IV strategy, that is complementary to the first IV strategy, uses the GDP growth rates of OECD countries as an instrument for international trade openness of SSA economies. Higher real GDP growth of OECD countries can increase trade openness of SSA countries through two main channels: the supply channel (higher OECD GDP growth increases OECD countries exports of goods and services) and the demand channel (higher OECD GDP growth leads to an increase in the consumption of goods and services produced by Sub-Saharan African countries). The fact that Sub-Saharan African countries' GDP is only a tiny fraction of OECD countries' GDP ensures that variations in OECD countries' GDP growth are plausibly exogenous to within-country variations of Sub-Saharan African countries' openness to international trade.

The main finding is that greater openness to international trade causes economic growth in Sub-Saharan Africa. The instrumental variables estimates suggest that, on average, a one percentage point increase in the ratio of exports plus imports over GDP in SSA countries is associated with a

3 See Miguel et al. (2004), Barrios et al. (2010), and Bruckner and Ciccone (2011).

short-run increase in GDP per capita growth of about 0.5 percent per year. The long-run effect is larger, reaching about 0.8 percent after ten years. Importantly, these results are robust to controlling for country fixed effects, year fixed effects, and other growth correlates related to political institutions and intra-national conflict. They are quantitatively in line with the cross-sectional growth estimates reported in, for example, the seminal paper by Frankel and Romer (1999).

The panel regressions also allow us to explore how the growth effects of openness to international trade vary across Sub-Saharan African countries. In the context of Sub-Saharan Africa, we are particularly interested in the role that international differences in ethnic divisions play in shaping the impact of international trade openness on economic growth. This is motivated by theoretical literature on the “voracity effect” (Lane and Tornell, 1998; Tornell and Lane, 1999). The voracity effect describes the tendency of social or ethnic groups to attempt to appropriate rents from economic windfalls. This literature predicts that trade windfalls can have adverse effects on economic growth in polarized countries with weak legal-political institutions. Consistent with the theoretical literature, we find that the positive effect of trade openness on economic growth significantly declines with ethnic polarization.⁴ Hence, while for Sub-Saharan Africa as a whole increases in international trade openness were, on average, good for growth, our findings call for some caution in expecting large growth benefits associated with international trade openness in countries that are characterized by strong ethnic divisions. In that regard, our results echo Easterly and Levin (1997) who document that strong ethnic divisions are associated with growth-prohibiting policies.

There are several reasons why we focus on Sub-Saharan African countries. The first is that the IV strategies are particularly suitable for SSA. The agricultural sector in these economies is large: according to WDI 2011, roughly one-third of GDP comes from agriculture, and over two-

4 While there is a significant interaction effect between trade and ethnic polarization, there is no significant interaction effect between trade and ethnic fractionalization. This asymmetry in results with the two ethnic diversity measures is consistent with the Lane and Tornell voracity model. The voracity model predicts that the voracity effect is strongest when there are two powerful groups, and that the effect diminishes as the number of groups increase. This non-linearity is captured by the polarization index, but not by the fractionalization index.

thirds of the population is employed in agriculture, which makes rainfall a powerful instrument as a determinant of SSA growth. Research by Barrios et al. (2010) has shown that the significant effects of rainfall on GDP are limited to the Sub-Saharan African region; this in turn implies that the rainfall IV strategy used in this paper is limited to the Sub-Saharan African region. Also, Sub-Saharan African GDP is only a tiny fraction of OECD GDP. Hence, GDP growth of OECD countries is plausibly exogenous to variations in Sub-Saharan African countries' openness to international trade. It is questionable whether OECD GDP growth is exogenous to changes in international trade openness of other developing regions, such as Asia or Latin America. These economies are in GDP terms much larger than Sub-Saharan African economies.

In addition, it is important to note the significant policy interest in factors associated with economic growth in Sub-Saharan Africa. SSA is lagging other regions in terms of poverty reduction, though with signs of progress since the mid-1990s (Chen and Ravallion, 2010). It is, therefore, understandable from the perspective of the Millennium Development Goals that there is a significant policy interest in factors driving economic growth in Sub-Saharan Africa. Openness to international trade is one of these factors; see, for example, the Africa Competitiveness Report (2011), IMF (2011), or World Bank (2011, 2012). Although international trade is cited as a key factor in numerous reports issued by these organizations, the policy recommendations cover not only the need for further reductions in import tariffs but also a broad policy agenda aiming to reduce the costs of international trade.⁵ Some of these recommendations might entail some costs, either fiscal costs associated with the reduction of tariffs or with needed public investments in infrastructure. Hence the gains from trade in terms of economic growth seems like an important consideration, especially because it is unlikely that most policy interventions that would raise the incidence of international trade in GDP will not be subject to impact evaluations. Our paper seeks to contribute to this important policy debate -- from an empirical angle -- by using panel data

⁵ It is also noteworthy that, on average, African economies have the highest import tariffs in the world. See, for example, Figure 3.3 in the World Bank's 2009 *World Development Report*.

regressions and novel IV strategies. The hope is that the results will add to our understanding of how and to what extent exogenous increases in international trade cause economic growth in Sub-Saharan Africa.

The rest of the paper is organized as follows. Section 2 discusses the data. Section 3 presents our estimation and identification strategies. Section 4 discusses the results from the baseline estimates linking trade openness with economic growth, which are used to compute residuals that are later used as IVs in the growth models. Rainfall is used as an IV for growth in Sub-Saharan Africa in this section. Section 5 presents the results on the effects of trade openness on growth, followed by a discussion of the role of ethnic divisions, as well as the results from our second IV estimations that rely on the GDP growth of OECD countries as an exogenous determinant of African trade openness. Section 6 concludes.

2. Data

The key variables for the subsequent econometric analyses are trade and GDP in developing and developed countries, with latter used as an IV. Rainfall is the other instrumental variable. In addition, we also include variables related to political institutions and ethnic polarization and fractionalization as additional controls and to test for heterogeneity in coefficient estimates. The following paragraphs describe the relevant data, their sources and the variable definitions.

Trade Openness and GDP. We obtain data on trade openness and real GDP per capita from the Penn World Table, version 7.0 (Heston et al., 2011). Following Ciccone and Alcala, we measure trade openness as the sum of exports plus imports (in constant US dollar) over PPP GDP.

Rainfall. Our data on year-to-year variations in rainfall are from the National Aeronautics and Space Administration (NASA) Global Precipitation Climatology Project (GPCP), version 2.1 (Adler et al., 2003). These data are available from 1979 and to 2009. The rainfall data come on a $2.5^{\circ} \times 2.5^{\circ}$ latitude-longitude grid. We aggregate the data to the country level by assigning grids to

the geographic borders of countries. We use satellite-based rainfall data because these data have a number of important advantages over gauge-station based rainfall data. As pointed out in Bruckner and Ciccone (2011) satellite-based rainfall data are less likely to suffer from measurement error that is due to the sparseness of operating gauge stations in Sub-Saharan African countries (especially after 1990). Also, as Bruckner and Ciccone (2011) point out, the number of operating gauge stations in a country may be affected by socio-economic conditions, which could lead to non-classical measurement error in gauge-station based rainfall data.

GDP Growth of OECD Trading Partners. We construct a bilateral-trade-weighted GDP growth rate of OECD trading partners for each country in our sample. For country c and year t , the trade-weighted GDP growth rate of OECD trading partner j is constructed as:

$$OECDGrowth_{ct} = \sum_{j=1}^{30} \theta_{cj} GDPGrowth_{jt}$$

where θ_{cj} is the sum of exports plus imports between country c and country j as a share of country c 's GDP. The bilateral trade data are from Head et al. (2010). Data on the real GDP growth rate of OECD countries are from the Penn World Table, version 7.0.

Other Variables. Data on the savings rate, constructed as one minus the private consumption and government GDP share, are from the Penn World Table, version 7.0. Data on civil conflict incidence are from the PRIO (2010) database on armed conflict. The Polity2 score is from the Polity IV (2011) database. Data on ethnic fractionalization and polarization are from Reynal-Querol (2001). The import and export volume index is from WDI (2011). For some summary statistics on these variables, see Data Appendix Table 1. For a list of the Sub-Saharan African countries in our sample, see Data Appendix Table 2.

3. Estimation and Identification Strategy

To examine the effects that within-country variations in trade openness (TRADE) have on real GDP per capita growth (GROWTH), we estimate the following econometric model:

$$(1) \quad GROWTH_{i,t} = \alpha_i + \beta_t + \kappa_i t + \eta TRADE_{it} + \theta Rainfall_{it} + \Gamma X_{i,t} + u_{it}$$

where α_i are country fixed effects that account for cross-country differences in geography, history, ethnicity and other time-invariant determinants of economic growth such as initial income per capita levels. The year fixed effects, β_t , capture common year shocks that affect both GDP per capita growth and trade openness across all countries, for example, common shocks to economic growth that are due to changes in the world business cycle or political events such as the end of the Cold War. $\kappa_i t$ is a country-specific linear time trend that captures additional within-country time series variation. The vector $X_{i,t}$ includes within-country variations in political institutions and civil conflict incidence. The error term, u_{it} , is clustered at the country level to allow for arbitrary serial correlation.

As a baseline, we estimate the average marginal effect η that within-country variations in trade openness have on economic growth. We then examine lagged effects of trade openness on economic growth by means of a distributed lag model where we include further lags of trade openness on the right-hand side of the estimating equation. By doing so, we can examine both short-run and longer-run growth effects of trade openness.

A necessary condition for consistent estimation of the growth effects of trade openness is that variations in trade openness are exogenous to economic growth. If economic growth itself has an effect on trade openness, then least squares estimation of η will not yield a consistent estimate. We employ two different, but complimentary, strategies to deal with this. The first strategy consists in directly estimating the response of trade openness to economic growth:

$$(2) \quad Trade_{it} = a_i + b_t + c_i t + \delta Growth_{it} + \gamma OECDGrowth_{it} + \Lambda X_{i,t} + e_{it}$$

If in equation (1) $\eta \neq 0$, then least squares estimation of equation (2) will not provide a consistent estimate of δ . We employ, therefore, a two-stage least squares estimation approach to equation (2), instrumenting GDP growth with year-to-year variations in rainfall. This instrument has been used in previous work by Miguel et al. (2004) and Brückner and Ciccone (2011). These authors use rainfall

to examine how GDP shocks affect civil war risk and within-country variations in political institutions in Sub-Saharan African countries. Barrios et al. (2010) show that rainfall's significant effect on GDP is limited to the group of Sub-Saharan African countries; in other continental regions, such as Asia or Latin America, there is no significant average effect. Given the limited effect of rainfall on income of other countries, our first estimation strategy focuses only on Sub-Saharan African countries.

The exclusion restriction in the two-stage least squares estimation of equation (2) is that conditional on GDP per capita growth, year-to-year variations in rainfall only affect trade openness through their GDP per capita growth effects. We will discuss and examine this exclusion restriction in detail in the section that follows.⁶

With a consistent estimate of δ in hand, we can use the residual variation in trade openness that is not due to economic growth, e_{it} , as an instrumental variable for trade openness in equation (1). By construction, this residual variation in trade openness is not driven by economic growth. Using this residual variation as an instrument in equation (1) eliminates biases that arise from a reverse effect of economic growth on trade openness. This first estimation strategy is commonly used in the business-cycle literature. See, for example, Blanchard and Perotti (2004) with an application to cyclically adjusted tax revenues; or Bruckner (2011) with an application to estimating the effects of foreign aid on economic growth.

Exogeneity of within-country variations in trade openness to economic growth is a necessary condition for consistent estimation of the growth effects of trade openness. However, it is not a sufficient condition. If there are time-varying variables that affect: (i) trade openness beyond economic growth; and (ii) economic growth beyond trade openness -- then the first estimation

6 We do not use variations in international commodity prices as instruments for economic growth (as has been done for example in Bruckner and Ciccone (2010) in the context of civil wars). The reason for this is that variations in the international commodity prices are likely to have direct effects on trade openness -- through changes in the relative price of tradables to non-tradables.

strategy suffers from an omitted variables bias.⁷

In the cross-section of countries, one example of bias arising from omitted variables are countries' geographic characteristics. Another example are countries' historical characteristics. Note however that in our estimation framework we control for country fixed effects. Therefore, time-invariant variables, such as history and geography, do not constitute a source of omitted variables bias in our regressions.

What about time-varying factors? The year fixed effects capture Sub-Saharan Africa wide changes in political institutions, global business-cycle effects, as well as global events such as the end of the Cold War. Thus these Sub-Saharan Africa wide factors are not part of the error term. Nevertheless, there could be country-specific factors which are time-varying that constitute an omitted variable in the sense of fulfilling conditions (i) and (ii). Take, for example, country-specific episodes of policy reform. These country-specific episodes of policy reform could be associated with reforms in trade policy as well as other reforms such as, for example, reforms of financial sector regulation or changes in fiscal and monetary policy. However, by itself the presence of such waves of policy reform does not imply that conditions (i) and (ii) are fulfilled. If these waves of policy reforms only affect economic growth, then they would not be part of the error term, e_{it} , in equation (2). It would be a different case, of course, if these trade policies also affect the distribution of income, for example, and changes in the income distribution affect trade openness beyond economic growth.

To address concerns of bias arising from time-varying omitted variables, our second strategy relies on the variable we labeled $OECDGROWTH_{it}$ – the trade-weighted real GDP growth rate of OECD trading partners (see Section 2 for details on how this instrument is constructed) – which we use as an instrument for trade openness. The assumption is that changes in economic conditions of

⁷ Note that both, conditions (i) and (ii) have to be fulfilled for the IV estimation strategy to suffer from omitted variable bias. This is stricter than in least squares estimation of, say, equation (1). In the least squares estimation of equation (1), omitted variables bias would imply that only condition (i) is satisfied. For omitted variables bias in the IV estimation both conditions (i) and (ii) have to be satisfied.

non-OECD countries have negligible effects on the GDP growth rate of OECD countries. For the group of Sub-Saharan African countries this exogeneity assumption is plausible: for all years since 1960, the GDP of the group of Sub-Saharan African countries is less than 3 percent of OECD GDP; and the GDP of the largest Sub-Saharan African economy (South Africa) is less than 1 percent of OECD GDP (WDI, 2011).

The exclusion restriction is that $OECDGROWTH_{it}$ should only affect Sub-Saharan African countries' GDP growth through trade openness. With regard to this exclusion restriction, the year fixed effects are an important ingredient in our estimating framework since they pick up Sub-Saharan Africa-wide variation in GDP growth that is due to OECD-wide growth in GDP. The instrumental variables regressions that use $OECDGROWTH_{it}$ as an instrumental variable therefore only use variations in OECD countries' GDP growth that is specific to each Sub-Saharan African country. That is, these are country-specific variations in GDP growth. They arise precisely because bilateral trade flows between each OECD and Sub-Saharan African country are country specific.

It is important to note that we use time-invariant bilateral trade flows to construct the trade-weighted OECD GDP growth instrument. Using time-invariant bilateral trade flows ensures that within-country variations in Sub-Saharan African countries' GDP growth do not affect the $OECDGROWTH$ instrument. We use the 2000 value of bilateral trade flows to maximize the number of bilateral trade flow observations. However, for robustness purposes, we will also present results that use initial, i.e. pre-determined, trade flows to construct the $OECDGROWTH$ instrument.

4. The Response of Trade Openness to Economic Growth

We begin our empirical analysis by estimating the response of trade openness to within-country variations in real GDP per capita growth. In turn, we discuss the quality of our instrumental variable, rainfall, when estimating the response of trade openness to within-country GDP per capita growth.

4.1 Baseline Estimates

This exercise quantifies the response of trade openness to economic growth. As discussed in Section 3, with an estimate of the response of trade openness to economic growth in hand, we can construct a series of trade openness that is exogenous to economic growth.

Table 1 presents our instrumental variables estimates of the within-country effect that economic growth has on trade openness. Column (1) reports panel data estimates that control for country fixed effects only. Column (2) adds year fixed effects, and column (3) adds country-specific linear time trends. The main finding is that economic growth has a significant negative effect on trade openness. The estimated coefficient in column (3) implies that on average a one percentage point higher GDP per capita growth rate was associated with a 1.8 percentage points lower GDP share of imports plus exports.

In column (4) we show that there continues to be a significant negative effect of economic growth on trade openness when controlling for lagged trade openness. The coefficient on lagged trade openness is positive and significant at the 1 percent level. The estimated coefficient, 0.75, implies an average half-life of shocks to trade openness of about 2.5 years. In this dynamic specification, the estimated impact response of trade openness to economic growth is -0.88. Hence, according to this dynamic panel specification, there is an approximately one-to-one relationship between trade openness and economic growth. On the one hand, this one-to-one relationship is not surprising: GDP is in the denominator of the trade openness variable; thus, in the absence of a reaction in exports and imports to GDP growth, one would expect precisely such a negative one-to-one relationship. On the other hand, the negative response of trade openness to economic growth, while perhaps not surprising from a purely theoretical point of view, is an important empirical result: it implies that when estimating the within-country effect that trade openness has on economic growth, there is a negative reverse causality bias that downward biases the least squares estimate of the causal effect that trade openness has on economic growth.

We demonstrate that this first finding is robust to controlling for the incidence of civil conflict, political institutions, and the GDP growth of OECD trading partners in column (5). Neither civil conflict incidence nor countries' Polity2 scores are significantly correlated with trade openness. However, GDP growth of OECD trading partners has a significant positive effect on Sub-Saharan African countries' trade openness. In particular, this significant estimate shows that, beyond an effect that GDP growth of OECD countries has on GDP growth of Sub-Saharan African countries, there is a direct effect on Sub-Saharan African countries' trade openness.

In column (6) of Table 1 we show that GDP growth continues to have a significant negative effect on trade openness when excluding the top and bottom 1 percentile of rainfall observations. Our finding of a negative effect of economic growth on trade openness is thus robust to excluding extreme drought and flood years. Quantitatively, the estimated coefficient on GDP growth, -1.08, is significantly different from zero at the 5 percent level. However, it is not significantly different from -1 (p-value 0.85). This reconfirms our previous finding that there is an approximately one-to-one relationship between GDP growth and trade openness of Sub-Saharan African countries.

For comparison purposes, we report in Panel B of Table 1 least squares and system-GMM estimates. These estimates are also negative in sign and statistically significant for most specifications. However, quantitatively, they are less than half the size of the instrumental variables estimates that we reported in Panel A of Table 1. One reason for this difference in size is reverse causality bias: if trade openness has a positive effect on economic growth then the least squares and system-GMM estimates are upward biased. The instrumental variables estimates that use rainfall as an instrument for GDP growth do not suffer from this reverse causality bias because year-to-year variations in rainfall are exogenous to economic conditions of Sub-Saharan African countries. Another reason for the quantitatively larger (in absolute value) instrumental variables estimates is measurement error. It is well known that national accounts statistics of Sub-Saharan African countries are plagued by measurement error. To the extent that this measurement error is classical,

it will attenuate the least squares estimates towards zero but not the instrumental variables estimates.

4.2 Discussion of Instrument Quality

The quality of rainfall as an instrument for GDP growth in terms of first-stage fit is reasonable. The first-stage estimates on rainfall's effect on GDP growth are positive and significant at the 1 percent level; the joint first-stage F-statistic on rainfall is around 10 in column (3) and around 9 in the columns that follow. According to the tabulations in Stock and Yogo (2005), this F-statistic implies that we can reject the hypothesis that the IV size distortion is larger than 15 percent (the second most stringent criteria listed in Stock and Yogo) at the 5 percent significance level.

What about the exclusion restriction? The assumption in the instrumental variables regression is that rainfall only affects trade openness through its effect on GDP growth. To examine empirically whether there are any significant effects of rainfall on trade openness beyond GDP growth, we follow Acemoglu et al. (2008) and use the savings rate as an additional instrument for GDP growth. It seems clear that the savings rate is not as exogenous to politico-economic conditions as is rainfall. This is the main reason why our instrumental variables analysis relies on rainfall as an instrument for GDP growth. Also, as is well understood, tests of the exclusion restriction are not bullet-proof evidence that indeed instruments are valid. This is because these are joint tests and they require at least one valid instrument.

With these caveats in mind, we report in column (1) of Table 2 instrumental variables estimates that use rainfall as well as the savings rate as instrumental variables for GDP growth. The estimated coefficient on GDP growth, -1.42, is significant at the 1 percent level. And the p-value on the Hansen J-test is 0.57. Hence, the Hansen J test does not reject the null that the instruments are jointly valid. To show also in a more intuitive way that, indeed, rainfall's effect on trade openness beyond economic growth is statistically insignificant and quantitatively small we report in column

(2) of Table 2 estimates where we include rainfall directly in the second stage. For comparison purposes, we report in column (3) the reduced-form estimates of rainfall on trade openness. The estimates on rainfall in column (2) are less than 15 percent the size of the reduced-form estimates in column (3). Hence, conditional on economic growth we find that rainfall has only very small effects on trade openness. And statistically, these effects are insignificant: the p-value in column (2) on rainfall is 0.57. We now turn to reporting our estimates of the within-country effect that trade openness has on economic growth.

5. The Effects of Trade Openness on Economic Growth

The preceding analysis in Section 4.1 revealed that the commonly used measure of trade openness (the GDP share of imports plus exports) is strongly endogenous to within-country variations in GDP per capita growth. In particular, the previous analysis revealed that there is a nearly one-to-one negative relationship between trade openness and countries' GDP per capita growth. Hence, least squares estimation of the within-country effect of trade openness on economic growth is downward biased.

To correct for this negative reverse causality bias, we report in Panel A of Table 3 instrumental variables estimates that use the residual variation in trade openness which is not due to economic growth (see Section 2 for a detailed discussion of this estimation strategy). The IV estimates in column (1), that control for country and year fixed effects as well as country-specific linear time trends, yield a coefficient on trade openness of about 0.5. This estimated coefficient is significantly different from zero at the 1 percent significance level. The estimate is robust to controlling for direct effects of rainfall and the savings rate on economic growth (column (2)), controlling for lagged GDP growth (column (3)), controlling for civil conflict incidence and political institutions (column (4)), and excluding extreme rainfall observations (column (5)).

Panel B of Table 3 reports estimates that do not instrument trade openness. The estimated

coefficient on trade openness is, in this case, negative and significant. However, given that Section 4.1 revealed a strong negative effect of economic growth on trade openness, the negative coefficient in Panel B suffers from a negative reverse causality bias. The estimates in Panel B do not capture, therefore, the causal effects that trade openness has on economic growth.

While the estimates in Table 3 reflect the short-run effect that trade openness has on economic growth, it is also possible to study the long-run growth effects with the annual panel data. This can be done by including additional lags of trade openness on the right-hand side of the regression and summing up the coefficients on the contemporaneous and lagged effects of trade openness. In Table 4, column (2), we report estimates when including up to five lags of trade openness on the right-hand side of the regression. The sum of the estimated effects, 0.67, is positive and significant at the 1 percent level. Repeating this exercise for up to ten lags yields a cumulated effect of 0.89. This cumulated effect is significantly different from zero at the 1 percent significance level. Hence, the distributed lag exercise shows that also in the longer-run trade openness has a significant positive effect on economic growth. Quantitatively, the size of the estimated effects is in line with estimates obtained in cross-country regressions that focus on the long-run relationship between trade openness and growth as in Frankel and Romer (1999).

5.1 The Role of Ethnic Polarization

Beyond the significant positive average effect of trade openness on economic growth, an important issue is how the effect of trade openness varies across Sub-Saharan African countries as a function of ethnic divisions. A number of papers have traced poor policy performance of many Sub-Saharan African countries over the past half century to strong ethnic divisions that are prevalent in these countries (see for example, Easterly and Levin, 1997). Other papers have traced the incidence of civil conflict -- which, over the past three decades, has been particularly high in the group of Sub-Saharan African countries -- to ethnic polarization (e.g. Montalvo and Reynal-Querol, 2005a,b).

However, these papers are concerned with direct effects of ethnic divisions on economic growth and conflict. These direct effects are captured in our regressions by the country fixed effects.

Voracity models such as those in Tornell and Lane (1999) and Lane and Tornell (1998) predict, on the other hand, heterogeneity in the marginal effect of trade windfalls on economic growth. Specifically, these models predict that the voracity effect is strongest in countries where there are two groups of equal size claiming transfers from the government budget. The voracity effect diminishes as the number of groups exceeds two; it is not present in a homogenous country. The voracity effect described in the models of Lane and Tornell calls, therefore, for a measure of polarization, and not fractionalization. This is because the index of fractionalization is strictly increasing in the number of ethnic groups. In other words, the fractionalization index is not closely tailored to the non-linear relationship described in the voracity model between the number of groups and the voracity effect. The polarization index, on the other hand, is maximized when there are two groups which are of equal size, it is zero if there is one group only, and decreases as the number of groups exceeds two. This is exactly the non-linear relationship described in the voracity model between the number of groups contesting for resources and the extent of the voracity effect.⁸

In column (1) of Table 5 we report results from an interaction model where we allow the marginal effect of trade openness on economic growth to vary with cross-country differences in ethnic polarization. We note that we do not include directly the ethnic polarization index on the right-hand side of the regression because the regressions already control for country fixed effects (the ethnic polarization index is time-invariant). The main finding in column (1) is a significant negative interaction effect between trade openness and ethnic polarization. The significant negative interaction effect implies that the growth benefits of trade openness are significantly attenuated by ethnic polarization. Because we compute the interaction term as $Openness_{it} * (Ethpol_i - Av(Ethpol_i))$, the estimate on *Openness* reflects the marginal effect at sample mean values of ethnic polarization.

⁸ See also Montalvo and Reynal-Querol (2005) for further discussion on differences between the fractionalization and polarization index.

The estimate on *Openness* is around 0.5. Hence it is very similar to the average marginal effect that we reported in Table 3. The negative coefficient on the interaction term, -0.72, implies that the predicted marginal effect varies significantly with ethnic polarization. At the sample minimum of ethnic polarization (0.02), the predicted marginal effect is 0.88 and has a standard error of 0.18; at the sample maximum ethnic polarization (0.84) the predicted marginal effect is 0.29 and has a standard error of 0.11. These numbers imply that: (i) the marginal effect of trade openness on economic growth is significantly positive across the entire range of polarization; and (ii) the effect at the sample minimum of polarization is about three times the effect at the sample maximum. Ethnic polarization, therefore, plays a significant role in shaping the effect that openness to international trade has on economic growth.

In column (2) of Table 5 we report interaction estimates that use an index of ethnic fractionalization. The main finding is that the linear effect of trade openness on economic growth is positive and significant; and the interaction between trade openness and ethnic fractionalization is negative but insignificant. To interpret this last result, it is important to note that the fractionalization index is strictly increasing in the number of groups. In contrast, the polarization index is maximized when there are two groups of equal size. The fractionalization index does not relate, therefore, as well to the voracity model as the polarization index. In fact, as the number of groups exceeds two, the fractionalization index increases, while the voracity model predicts in this case a weaker -- rather than stronger -- voracity effect.

In column (3) of Table 5 we report results when controlling for additional interaction terms that capture differences in Sub-Saharan African countries' geography and colonial history. The ethnic fragmentation of countries is a more exogenous variable than, say, measures of institutional quality. But differences in countries' geography and colonial history might still be driving the results. To address this concern, we include as additional right-hand-side controls an interaction between trade openness and the share of countries' mountainous terrain. We also include interaction

terms between trade openness and indicator variables that are unity if a country was a British or French colony. The main message is that the interaction between ethnic polarization and trade openness continues to be negative and significant when controlling for these additional interaction terms.

5.2 IV Estimates Using OECD Trade-Weighted GDP Growth

An alternative instrumental variables approach that we discussed in detail in Section 2 consists in using the trade-weighted GDP growth rate of OECD countries. In Table 6 we report two-stage least squares estimates that use this variable as an instrument for trade openness. For comparison purposes to the previous estimates reported in Section 5, column (1) of Table 6 reports two-stage least squares estimates for the Sub-Saharan African sample where there are available satellite data on annual rainfall (the 1980-2009 period). With this IV approach the estimated coefficient on trade openness is 0.56. This coefficient is significantly different from zero at the 1 percent level. And the first-stage fit is also strong: the F-statistic for the trade-weighted OECD GDP growth instrument is over 90.

Table 7 shows that the reason for the significant positive first-stage effect of the OECD GDP growth instrument on Sub-Saharan African countries' trade openness is a significant positive effect on exports and imports. The significant positive coefficient in column (1) implies that, on average, a one percentage point increase in OECD GDP growth increased the growth rate of SSA countries' import volume index by over 1.7 percentage points. Column (2) shows that the effect on the growth rate of SSA countries' export volume index is around 0.8 percentage points. Thus, the effect on exports is a bit smaller than on imports. However, for both imports and exports the effect of OECD GDP growth is positive, and significantly different from zero at the 1 percent level.

In column (2) of Table 6 we demonstrate that this instrumental variables estimation strategy yields similar results if we use the pre-1980 trade-flow to construct the trade-weighted OECD GDP

growth instrument.⁹ The first-stage fit is in this case a bit weaker but the F-statistic is still around 23. The estimated second-stage coefficient on trade openness is 0.73, thus a bit larger than in column (1), but also positive and significant at the 1 percent level.

There are a number of further issues that the alternative instrumental variables approach enables us to explore. First, the trade-weighted OECD GDP growth instrument is also available for the period before 1980, i.e. from 1950-2009.¹⁰ In column (3) we report results for the longest possible Sub-Saharan African sample. The main finding is that in this sample the coefficient on trade openness is 0.51. This coefficient is significantly different from zero at the 1 percent level. It is, however, not significantly different from the coefficient obtained for the post-1980 period.

A second issue that the trade-weighted OECD GDP growth instrument enables us to explore is whether the effect of trade openness on economic growth is significantly different when using a world sample. The first instrumental variables approach that used rainfall as an instrument for GDP growth was limited to the Sub-Saharan African region. The reason is that rainfall's significant effect on GDP growth is limited to that region. In contrast, the trade-weighted OECD GDP growth instrument should also work for other regions. Column (4) of Table 6 shows that the coefficient for the world sample is 0.49. This coefficient is, therefore, not significantly different from the Sub-Saharan African sample.

One issue, of course, that needs to be kept in mind is that while GDP growth of Sub-Saharan African countries has an expectedly small effect on OECD countries' GDP growth -- this may not be the case for other regions. For example, changes in politico-economic conditions in Arab countries which are major oil producers could have repercussions on GDP growth of OECD countries. It is unclear how large this effect is. However, a fair evaluation of this issue is that trade-weighted OECD GDP growth is not as clean an instrument for trade openness in a global sample as

9 We have also tried using bilateral distances instead of bilateral trade flows to compute the trade-weighted OECD GDP growth instrument. However, this did not lead to a significant first-stage fit.

10 Note that including the pre-1980 period leads to a strongly unbalanced sample as the PWT data for Sub-Saharan African countries are unevenly available for the pre-1980 period.

it is for the group of Sub-Saharan African countries. Also, the first-stage fit for the world sample is much weaker than in the Sub-Saharan African sample. This continues to be the case when excluding OECD countries from the world sample, see column (5). In addition, column (6) shows that when both OECD countries and SSA countries are excluded, the first-stage fit between the instrument and trade openness is only significant at the 5 percent level, thus raising concerns about instrument weakness.

A third issue that we can address with this second instrumental variable in hand is the empirical examination of the exclusion restriction. In column (1) of Table 8, we report two-stage least squares estimates that use the residual variation in trade openness (that is not due to economic growth, see Section 4) and the trade-weighted OECD GDP growth variable as excluded instruments. The two-stage least squares estimate on trade openness is 1.01 and significant at the conventional confidence level. The Hansen J-test does not reject the hypothesis that the instruments are jointly uncorrelated with the second-stage error term. In column (2) of Table 8 we also document that, conditional on trade openness, the residual variations in trade openness that is not due to economic growth is not significantly correlated with economic growth. On the other hand, the reduced-form estimates in column (3) show that residual openness has a significant positive effect on economic growth. Hence, these tests of the exclusion restriction do not reject the hypothesis that the residual variation in trade openness which is not due to economic growth is a valid instrument.

6. Conclusion

Estimates of the effect of international trade on development remain contentious, while the policy agenda to raise the level of trade in Sub-Saharan Africa has widened to a rather broad set of policies. The literature, however, has raised concerns about the validity and interpretation of cross-country evidence. In particular, it remains unclear whether a positive correlation between trade

openness (even when instrumented by geography as in Frankel and Romer 1999) and growth withstands the inclusion of the historical roots of governance in cross-country estimations. This paper tackled the debate with panel data and new IV strategies applied mainly to the case of Sub-Saharan Africa.

Our approaches entailed two instrumental-variable identification strategies. One relied on rainfall data to identify the effect of growth on trade, which in turn allowed us to use the residual as an IV for trade in the growth model to correct for reverse causality bias. The second strategy relied on the GDP growth of OECD economies as an IV for trade openness in Sub-Saharan Africa (and other developing countries).

The results appear to be robust and the IVs seem to be both valid and relevant. On average, trade openness appears to have a significant positive effect on growth in Sub-Saharan Africa. A one percentage point increase in the ratio of trade over GDP in Sub-Saharan Africa is associated with a short-run increase in growth of approximately 0.5 percent per year. The long-run effect is larger, reaching about 0.8 percent after ten years. Consistent with the theoretical voracity models developed by Lane and Tornell, the growth effects tend to decline with ethnic polarization, therefore calling for some caution in expecting large growth gains from openness to international trade in strongly polarized countries.

In the process, the evidence suggests other findings of interest for the literature. Importantly, trade openness is endogenous to growth, but this effect is negative. This is expected because GDP is in the denominator of the trade openness ratio. Thus least squares estimates of the effect of openness on growth tend to be downward biased. Finally, ethnic fractionalization is immaterial for the relationship between trade and growth, whereas ethnic polarization is highly significant. These contrasting findings indeed suggest that the voracity effect is at play, because rent seeking is expected to be at a maximum when groups are polarized (and not simply when fractionalization is high). These results are robust to the inclusion of country fixed effects, time effects, country-

specific linear time trends, as well as interactions between trade openness and topography and between trade openness and colonial heritage.

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Table 1. Response of Trade Openness to Economic Growth

Dependent Variable: Openness						
	(1)	(2)	(3)	(4)	(5)	(6) Excl. Top/Bottom 1 Percentile Rain
Panel A: GDP instrumented by Rainfall						
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
$\Delta \ln(\text{GDP}), t$	-2.55** (1.00)	-3.65*** (1.30)	-1.89* (0.95)	-0.88** (0.38)	-0.87** (0.39)	-1.08** (0.42)
Openness, $t-1$				0.72*** (0.04)	0.72*** (0.05)	0.74*** (0.05)
OECD GDP Growth, [2000 Trade Weighted], t					0.71** (0.27)	0.83*** (0.27)
Civil Conflict, t					-0.02 (0.02)	
Polity2, t					-0.00 (0.09)	
First Stage for $\Delta \ln(\text{GDP}), t$						
Rainfall, t	0.050*** (0.013)	0.040*** (0.014)	0.047*** (0.016)	0.051*** (0.016)	0.051*** (0.017)	0.052*** (0.017)
First-stage F-statistic	15.46	7.69	10.77	9.72	9.37	9.46
Panel B: GDP not instrumented						
	LS	LS	LS	SYS-GMM	SYS-GMM	SYS-GMM
$\Delta \ln(\text{GDP}), t$	-0.15 (0.12)	-0.24** (0.10)	-0.28*** (0.10)	-0.47** (0.18)	-0.47** (0.18)	-0.47** (0.19)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes	Yes
Country Trends	No	No	Yes	Yes	Yes	Yes
Observations	1180	1180	1180	1180	1180	1157

Note: The method of estimation in Panel A is two-stage least squares. The excluded instrument is the log of rainfall. In Panel B, columns (1)-(3), the method of estimation is least squares; Panel B, columns (4)-(6), system-GMM. The estimates reported in Panel B are based on the same set of control variables as shown in Panel A, however, estimates on the set of control variables are not reported in Panel B for space purposes. The dependent variable, *Openness*, is defined as exports plus imports over PPP GDP. Column (6) excludes the top/bottom 1st percentile of rainfall observations. *Significantly different from zero at the 10 percent significance level, ** 5 percent significance level, *** 1 percent significance level.

Table 2. Response of Trade Openness to Economic Growth
(Test of Exclusion Restriction)

Dependent Variable: Openness			
	(1)	(2)	(3)
	2SLS	2SLS	LS
$\Delta \ln(\text{GDP}), t$	-1.42*** (0.41)	-1.39*** (0.40)	
$\ln(\text{Rainfall}), t$		-0.02 (0.04)	-0.14*** (0.04)
Hansen J, p-value	0.57	.	.
		First Stage $\Delta \ln(\text{GDP}), t$	
$\ln(\text{Rainfall}), t$	0.038** (0.016)	.	.
Savings Rate	0.281** (0.118)	0.281** (0.118)	.
First-stage F-statistic	6.72	5.66	.
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Country Trends	Yes	Yes	Yes
Observations	1180	1180	1180

Note: The method of estimation in columns (1) and (2) is two-stage least squares; column (3) least squares. The dependent variable, *Openness*, is defined as exports plus imports over PPP GDP. *Significantly different from zero at the 10 percent significance level, ** 5 percent significance level, *** 1 percent significance level.

Table 3. Effect of Trade Openness on Economic Growth

Dependent Variable: $\Delta \ln(\text{GDP})$					
	(1)	(2)	(3)	(4)	(5) Excl. Top/Bottom 1 Percentile Rain
Panel A: Openness instrumented by Residual Variation that is not due to GDP Growth					
	2SLS	2SLS	2SLS	2SLS	2SLS
Openness, t	0.53*** (0.18)	0.51*** (0.18)	0.52*** (0.17)	0.51*** (0.18)	0.52*** (0.18)
Rainfall, t		0.08** (0.03)	0.08** (0.03)	0.08** (0.03)	0.09** (0.03)
Savings Rate, t		0.48*** (0.13)	0.49*** (0.13)	0.48*** (0.12)	0.49*** (0.13)
$\Delta \ln(\text{GDP})$, t-1			0.07 (0.05)		
Civil Conflict, t				-0.03* (0.02)	
Polity2, t				0.00 (0.00)	
First Stage for Openness, t					
Residual Openness, t	0.50*** (0.09)	0.51*** (0.09)	0.50*** (0.09)	0.51*** (0.09)	0.50*** (0.09)
First-stage F-statistic	32.91	31.66	32.79	32.22	30.67
Panel B: Openness not instrumented					
	LS	LS	SYS-GMM	LS	LS
Openness, t	-0.07*** (0.01)	-0.05*** (0.01)	-0.07*** (0.02)	-0.05*** (0.02)	-0.05*** (0.02)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Country Trends	Yes	Yes	Yes	Yes	Yes
Observations	1180	1180	1180	1180	1157

Note: The method of estimation in Panel A is two-stage least squares. The excluded instrument is the residual variation in openness that is not due to GDP growth (obtained from the estimates in Table 1). See pages 8 to 10 in the paper for a detailed explanation of this estimation strategy. In Panel B, the method of estimation is least squares (columns (1), (2), (4), and (5)) or system-GMM (column (3)). The estimates reported in Panel B are based on the same set of control variables as shown in Panel A, however, estimates on the set of control variables are not reported in Panel B for space purposes. The dependent variable is real GDP per capita growth. Column (5) excludes the top/bottom 1st percentile of rainfall observations. *Significantly different from zero at the 10 percent significance level, ** 5 percent significance level, *** 1 percent significance level.

Table 4. Effect of Trade Openness on Economic Growth
(Long-Run vs. Short-Run Effects)

	Dependent Variable: $\Delta \ln(\text{GDP})$		
	(1)	(2)	(3)
	Effect in Year t	Cumulative Effect 5-years	Cumulative Effect 10-years
	2SLS	2SLS	2SLS
Openness	0.53*** (0.18)	0.67*** (0.07)	0.89*** (0.10)
First-stage F-statistic	32.74	244.63	239.97
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Country Trends	Yes	Yes	Yes
Observations	1180	1180	1180

Note: The method of estimation is two-stage least squares. The excluded instrument is the residual variation in openness that is not due to GDP growth (obtained from the estimates in Table 1). See pages 8 to 10 in the paper for a detailed explanation of this estimation strategy. The dependent variable is real GDP per capita growth. *Significantly different from zero at the 10 percent significance level, ** 5 percent significance level, *** 1 percent significance level.

Table 5. Effect of Trade Openness on Economic Growth
(The Role of Ethnic Polarization)

	Dependent Variable: $\Delta \ln(\text{GDP})$		
	(1)	(2)	(3)
	2SLS	2SLS	2SLS
Openness	0.50*** (0.04)	0.52*** (0.04)	0.33*** (0.08)
Openness*Ethnic Polarization	-0.72** (0.36)		-0.95** (0.41)
Openness*Ethnic Fractionalization		-0.29 (0.20)	0.71* (0.37)
Openness*Mountainous Terrain			0.10** (0.04)
Openness*British Colony			0.48*** (0.15)
Openness*French Colony			0.46*** (0.17)
First-stage F-statistic	218.83	227.41	30.57
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Country Trends	Yes	Yes	Yes
Observations	1073	1073	1073

Note: The method of estimation is two-stage least squares. The excluded instrument is the residual variation in openness that is not due to GDP growth (obtained from the estimates in Table 1). See pages 8 to 10 in the paper for a detailed explanation of this estimation strategy. The dependent variable is real GDP per capita growth. *Significantly different from zero at the 10 percent significance level, ** 5 percent significance level, *** 1 percent significance level.

Table 6. Effect of Trade Openness on Economic Growth
(Sub-Saharan Africa vs. World Sample)

Dependent Variable: $\Delta \ln(\text{GDP})$						
	SSA Only			World Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
		Pre-1980 Trade Weights	Including 50s, 60s, 70s		Excluding OECD	Excluding OECD & SSA
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Second Stage for $\Delta \ln(\text{GDP})$						
Openness	0.46*** (0.11)	0.73* (0.38)	0.51*** (0.10)	0.49*** (0.16)	0.46*** (0.16)	0.40 (0.29)
First-stage F-statistic	91.13	23.22	27.64	8.11	7.60	4.68
First-Stage for Openness						
OECD GDP Growth, [2000 Trade Weighted]	0.88*** (0.09)		0.84*** (0.16)	1.18*** (0.41)	1.20*** (0.43)	2.26** (1.04)
OECD GDP Growth [Pre- 1980 Trade Weighted]		0.45*** (0.09)				
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country Trends	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1180	1180	1998	5013	4346	3166

Note: The method of estimation is two-stage least squares. The excluded instrument is OECD GDP growth. See page 7 in the paper for details on how this variable is constructed. The dependent variable is real GDP per capita growth. Columns (1)-(3) report estimates for the Sub-Saharan African sample; columns (4)-(6) report estimates for the world sample, with column (5) excluding OECD countries and column (6) excluding Sub-Saharan African countries as well as OECD countries. *Significantly different from zero at the 10 percent significance level, ** 5 percent significance level, *** 1 percent significance level.

Table 7. Effects of OECD GDP Growth on SSA Exports and Imports

	$\Delta \ln(\text{ExportVolumeIndex})$	$\Delta \ln(\text{ImportVolumeIndex})$
	(1)	(2)
	LS	LS
OECD GDP Growth [2000 Trade Weighted]	1.72*** (0.18)	0.82*** (0.36)
Country FE	Yes	Yes
Year FE	Yes	Yes
Country Trends	Yes	Yes
Observations	1180	1180

Note: The method of estimation is least squares. *Significantly different from zero at the 10 percent significance level, ** 5 percent significance level, *** 1 percent significance level.

Table 8. Effects of Trade Openness on Economic Growth
(Test of Exclusion Restriction)

	Dependent Variable: $\Delta \ln(\text{GDP})$		
	(1)	(2)	(3)
	2SLS	2SLS	LS
Openness	1.01* (0.54)	0.37** (0.14)	
Residual Openness		0.11 (0.07)	0.27*** (0.04)
Hansen J, p-value	0.51	.	.
	First Stage for Openness		
Residual Openness	0.18** (0.08)		.
OECD GDP Growth [2000 Trade Weighted]	0.80*** (0.14)	0.80*** (0.14)	.
First-stage F-statistic	70.64	30.61	.
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Country Trends	Yes	Yes	Yes
Observations	1180	1180	1180

Note: The method of estimation in columns (1) and (2) is two-stage least squares; column (3) least squares. The excluded instruments in column (1) are the residual variation in openness that is not due to GDP growth (obtained from the estimates in Table 1) and OECD GDP growth. In column (2) the excluded instrument is OECD GDP growth. The dependent variable is real GDP per capita growth. *Significantly different from zero at the 10 percent significance level, ** 5 percent significance level, *** 1 percent significance level.

Data Appendix Table 1. Descriptive Statistics

Variable	Source	Mean	Stdv.	Obs
Trade Openness	PWT 7.0	0.667	0.387	1180
GDP Growth	PWT 7.0	0.008	0.091	1180
OECD Trade-Weighted Growth	Heat et al., PWT 7.0	0.005	0.018	1180
Ln(Rainfall)	GPCP V2.1	6.713	0.642	1180
Polity2	Polity IV	-1.653	5.677	1180
Civil Conflict Incidence	PRIO/UPSALLA	0.262	0.440	1180
Export Volume Index Growth	WDI 2011	0.040	0.267	1180
Import Volume Index Growth	WDI 2011	0.037	0.245	1180
Ethnic Polarization	Reynal-Querol	0.545	0.170	1073
Ethnic Fractionalization	Reynal-Querol	0.672	0.234	1073
Mountainous Terrain	Miguel et al.	1.583	1.414	1180
British Colony	Acemoglu et al.	0.393	0.489	1180
French Colony	Acemoglu et al.	0.393	0.489	1180

Data Appendix Table 2. List of Sub-Saharan African Countries in Sample

Angola	Chad	Gambia, The	Madagascar	Nigeria	Swaziland
Benin	Congo, Dem. Rep.	Ghana	Malawi	Rwanda	Tanzania
Botswana	Congo, Rep. of	Guinea	Mali	Senegal	Togo
Burkina Faso	Cote d'Ivoire	Guinea-Bissau	Mauritania	Sierra Leone	Uganda
Burundi	Djibouti	Kenya	Mozambique	Somalia	Zambia
Cameroon	Ethiopia	Lesotho	Namibia	South Africa	Zimbabwe
Centr. Afr. Rep.	Gabon	Liberia	Niger	Sudan	