# Distance to Growing Markets, Logistics Quality and Sub-Saharan African Exports

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## Abstract

A typical person in sub-Saharan Africa is a long way from world markets. Moreover, they are further from world markets now than they were in 1980 due to shifts in the location of world production. This partly reflects slower growth within Africa than for the world as a whole. Yet despite slower growth in Africa, African exports have become increasingly regionalized. By 2005, a country in sub-Saharan Africa typically exported twice as much to a country in their own region, after accounting for economic size and bilateral distance. This regionalisation was not present in the early 1980s and has become stronger over time.

We find evidence of positive neighbourhood effects through exports. Using country-pair fixed effects in a gravity equation we estimate that, for a typical country pair, one per cent trading partner growth increases bilateral exports to that country by about 0.8 per cent. We find evidence that sub-Saharan countries may benefit less from growth in their own region than this typical relationship suggests. Countries may also benefit from changes in the logistics performance of their trading partners. We find that the impact of logistics performance on exports is economically and statistically significant for both own and trading partner logistics performance.

# Distance to Growing Markets, Logistics Quality and Sub-Saharan African Exports

## Introduction

Middle income countries (MICs) in sub-Saharan Africa such as Botswana, Angola and Mauritius have grown considerably over the past decade (and longer). Botswana's GDP per capita at real purchasing power parity has grown by 6.2 per cent per annum from 1970 to 2004.[1] GDP per capita in Mauritius has grown by 4.2 per cent per annum in the same period. More recently, South Africa, the biggest economy in the region, has had per capita economic growth of 2.7 per cent per annum from 2000 to 2004, with projections of higher growth in the future. Sub-Saharan Africa as a whole is forecast to grow 6.1 per cent in 2007 and 6.8 per cent in 2008 by the IMF (IMF 2007). Alongside the success stories there are many countries in sub-Saharan Africa that have become economically poorer. Per capita real GDP in the region as a whole has not grown at all since 1980, compared to average per capita growth of 1.9 per cent for the whole world.

Much of the growth in Africa over the past decade has been driven by resources, including oil. Oil exporting countries grew at 4.5 per cent per year from 1995-2005, while resource rich countries grew at 3.4 per cent and non-oil exporters grew at 1.3 per cent over the same period (World Bank 2007).

Economic growth in sub-Saharan countries may benefit the poor in neighboring low income countries (LICs). The effects on neighboring countries, called neighborhood effects, can include spillovers in knowledge (economic and social), stability, institutions, migration, investment and trade. Many of these spillovers and neighborhood effects have been documented, although not specifically for sub-Saharan Africa, and will not be discussed in detail here.[2] Our focus is on the potential contribution of trade.

The framework we use is a gravity equation. In this framework, bilateral trade between two countries is a positive function of their size and a negative function of the distance between them. This intuition is consistent with a number of trade models, with key theoretical foundations provided by Anderson (1979) and Bergstrand (1985).

There is a wealth of empirical support for the gravity model. Much of Africa's trade performance is claimed to be "explained" using cross-country studies of bilateral trade. For example, Foroutan and Pritchett (1993) conclude that, once one controls for the level of GDP and distance, intra-African trade is about what we would expect.

Distance, an important element in the traditional gravity equation, remains an important factor in determining bilateral trade, despite observed patterns of globalization. Anderson and van Wincoop (2004, p1) note

> The death of distance is exaggerated. Trade costs are large, even aside from trade policy barriers and even between highly integrated economies.

Countries tend to trade less with countries that are further away from them, after accounting for country size. Because of this, neighbours tend to be more important

[1] Calculated using the World Bank World Development Indicators, April 2007.

[2] See for example Portes and Rey 2005, Rauch and Trindale 2002, Overman, Redding and Venables 2003, Anderson and van Wincoop 2001, Loungani et al 2002, Keller 2002 and Javorcik 2004.

trading partners, and their economic growth tends to be more important for trade. These partner growth effects are of primary interest for this paper.

We investigate the effects of trading partner growth on exports using panel data. Panel data has numerous advantages over cross-section data, including the option to control for unobserved bilateral fixed effects. Furthermore, for our application, it is the within group variation in the variables over time that correctly identifies the effect of partner *growth* on exports.

We are by no means the first to use panel data to estimate gravity relationships. Brun et al (2005) use random effects and other estimators to confirm distance is still important. Coe & Hoffmaister (1999) investigate African trade patterns including a number of fixed effects. Rodrik (1998) argues Africa's relatively poor trade growth is attributable to slow GDP growth, but using cross-sectional and pooled data. This is also confirmed by Redding and Venables (2003) using country fixed effects but with cross-section data. To our knowledge, we are the first to use a full set of bilateral fixed effects.[3] This allows us to directly address the impacts of trading partners' growth and to test whether this effect is different within Africa.

The paper first describes the trade neighborhood facing a typical person in different regions of the world and how this has changed through time. A sub-Saharan African person is more economically distant than they used to be, because the countries nearby have grown slowly while those that are far away have grown more quickly.

Second, it discusses historical trade patterns and openness in sub-Saharan Africa. African exports have grown more slowly than elsewhere in the world. Furthermore, the share of African exports going to other African countries has increased: trade is becoming more regionalised.

Third, we proceed to explain trade patterns, including increased regionalization, using a gravity model. We find that using a fixed effects estimator still generates a sizeable coefficient on a country's GDP and that of its partner, so growth in trading partners is associated with higher trade. This is consistent with explanations that Africa's relatively slow trade growth is partly due to slow growth within its own region.

Our gravity model estimates confirm a pattern of increased regionalization in African trade. Not only are a pair of African countries more likely to trade with each other than anyone else, controlling for GDP and distance, but they have become more likely to trade with each other over time, controlling for changes in GDP. Our message holds for a variety of measures of trade.

We also investigate the role of a number of controls, notably a new logistics index created by the World Bank. Logistics is found to be an economically and statistically important determinant of trade, but the inclusion of logistics does not materially impact the size and significance of the other coefficients.

[3] We do not claim that their choice of method is inappropriate to their purposes. Brun et al (2005) are particularly interested in the distance coefficient, which fixed effects would eliminate, and use alternative methods to address potential endogeneity bias. Similarly, the fixed effects reported by Coe & Hoffmaister (1999) contain information of direct interest. Besides, computing power may have been an obstacle to a full specification of dummies given their use of a non-linear estimator.

## The Trade Neighborhood of Sub-Saharan Africa

Sub-Saharan Africa is a long way from the major economic markets in Europe, North America and East Asia. One way to measure this is to calculate the GDP weighted distance of a country from all other countries in the world. This measure will be lowest for countries that are closest to areas of high GDP and highest for countries that are far from economically important regions. To calculate this, we multiply the bilateral distance of country i to country j by the GDP of country j, and sum over all countries in the world.[4] We use a measure of bilateral distance that captures both the internal distance in a country and accounts for bilateral distance from a number of major cities.[5]

To aggregate the economic distance measures into regional measures, we use population weights.[6] The regional estimate of economic distance can therefore be interpreted as the average distance of a person in that region from world economic production.

A typical person in Sub-Saharan Africa was almost 50 per cent more distant from economic markets than a typical person in Europe and Central Asia (Figure 1). They were 13 per cent more distant from economic markets than a typical person in the world. There are regions that are further from world production than sub-Saharan Africa. People in Latin America and the Caribbean are, on average, slightly more distant from economic markets. People in Australia and New Zealand are much further from economic markets than people in sub-Saharan Africa, providing strong evidence that the tyranny of economic distance can be overcome.

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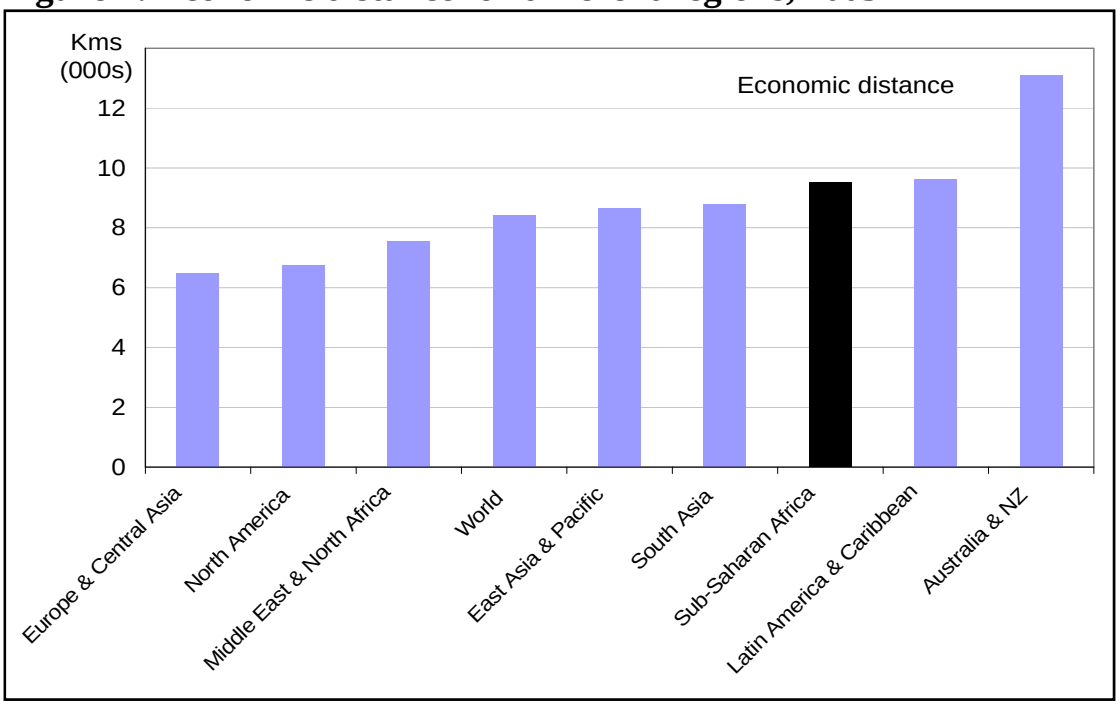
[4] Distance measure for country i is: $d_i = \frac{\sum_j GDP_j.d_{i,j}}{\sum_j GDP_j}$, where $d_{ij}$ is bilateral distance between countries i and j. GDP is in constant US$, as measured by the World Bank.

[5] The distance measure used is distw from CEPII, http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

[6] The measures for region R is $d_R = \frac{\sum_j POP_j.d_j}{\sum_j POP_j}$ for all j countries in region R.

**Figure 1: Economic distance for different regions, 2005**

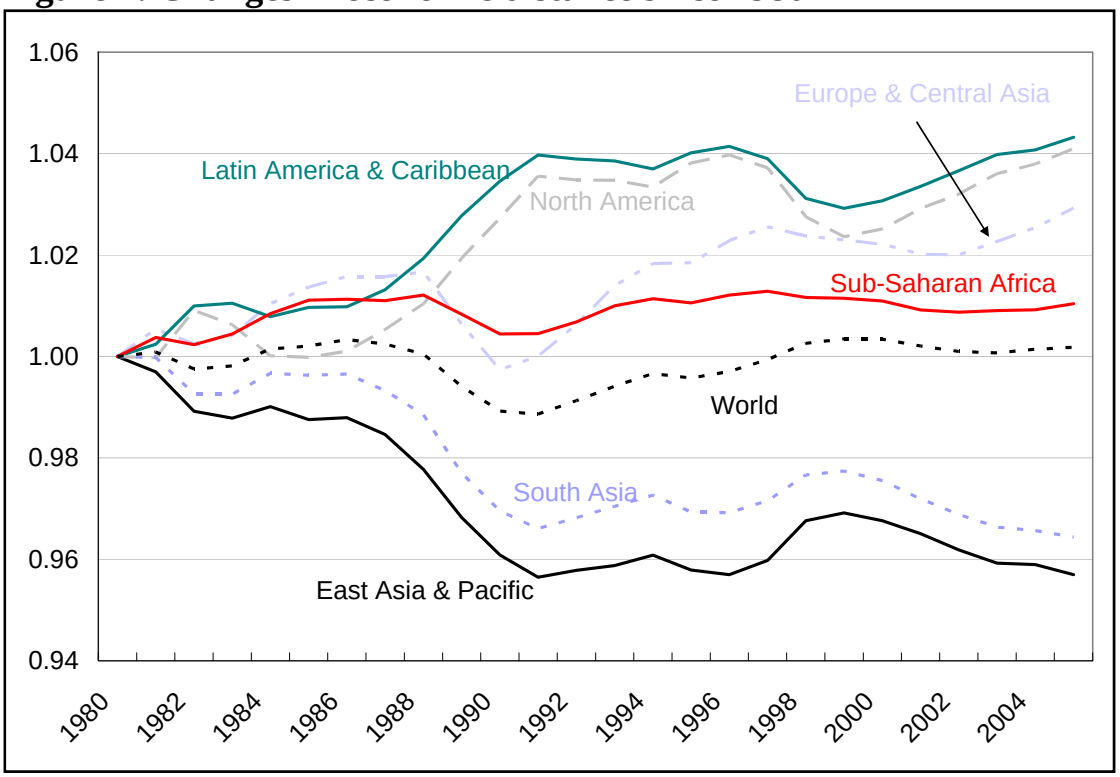



Notes: Country distance measures are aggregated using population weights. Source: Author's calculations.

The economic distance of sub-Saharan Africa from world markets has increased slightly since 1980 (Figure 2). The economic distance of East Asia and South Asia has fallen as these regions have become increasingly important in the world economy. The economic distance of North America and Europe has risen, again reflecting the shift in economic production to Asia.

Economic distance would be expected to be one factor affecting a country's exports. Declining economic distance would mean that a country's neighbors are growing faster than the rest of the world. In a gravity model framework, the increase in economic distance experienced by sub-Saharan Africa relative to the world would suggest that sub-Saharan trade would have grown more slowly than world trade, other things constant.

**Figure 2: Changes in economic distance since 1980**




Notes: Country distances are weighted according to population weights to give region figures. The base year is 1980 for each region. Source: Author's calculations.

## Sub-Saharan African Trade

Sub-Saharan Africa as a region appears to be fairly open. Trade, defined as imports plus exports, was 62.7 percent of GDP in 1980 and 66.3 per cent of GDP in 2004 (Table 1). In 1980 its trade to GDP ratio was amongst the highest in the world. By 2004, many other regions had achieved greater trade ratios and much greater increases in trade to GDP ratios.

**Table 1: Sub-Saharan trade as a share of GDP**

| Region | Trade (% of GDP) | |
|---|---|---|
| | 1980 | 2004 |
| Sub-Saharan Africa | 62.7 | 66.3 |
| South Asia | 20.8 | 38.9 |
| Middle East & North Africa | 64.8 | 66.3 |
| Latin American & Caribbean | 27.7 | 47.8 |
| East Asia & Pacific | 33.8 | 82.7 |
| European Monetary Union | 52.7 | 76.7 |
| World | 38.6 | 52.1 |

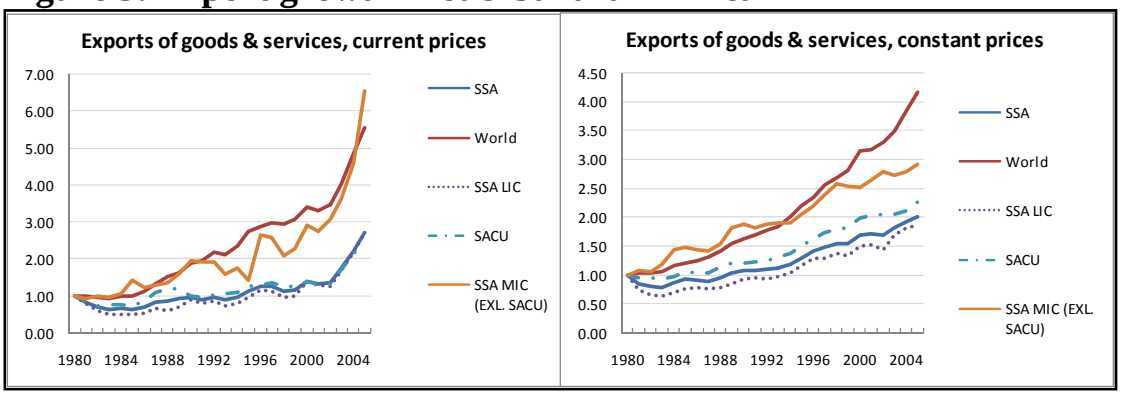
Source: World Development Indicators.

Total exports from sub-Saharan Africa have grown faster than world exports since 2002 in current US dollars (Figure 3, left panel). This reflects strong export growth for low-income countries and middle income countries, excluding the South African

Customs Union (SACU).[7] This recent export growth in US$ exports has followed slow export growth in sub-Saharan Africa for much of the 1980s and 1990s.

Exports indices for sub-Saharan Africa and the world in constant 2000 prices show that recent export growth in sub-Saharan Africa is primarily due to favourable price movements (Figure 3, right panel). In constant 2000 prices, exports from each category of sub-Saharan countries have grown more slowly than world exports since 1980 and there is no pronounced upward movement in exports since 2002.

## Figure 3: Export growth in sub-Saharan Africa



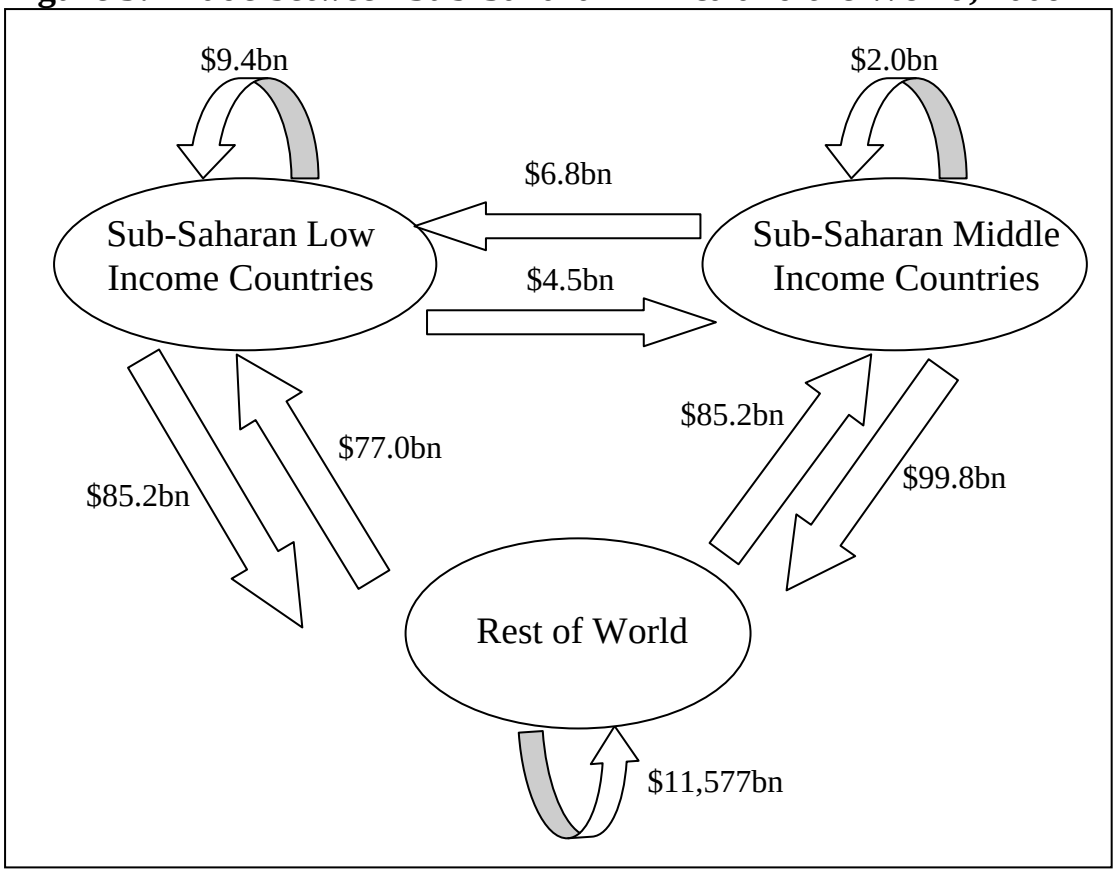

Source: World Bank World Development Indicators. LIC is low-income countries, MIC is middle-income countries and SACU is the South African Customs Union.

Most sub-Saharan African trade is with countries outside their own region (Figure 4).[8] Over 80 per cent of the exports from low-income sub-Saharan countries go to countries outside of the sub-Saharan region ($85.2bn in 2006). These countries only exported $4.5 billion to sub-Saharan middle income countries and $9.4 billion to other sub-Saharan low-income countries. A similar picture emerges for middle income countries, with the majority of exports going to countries outside the sub-Saharan region. Sub-Saharan countries also import mainly from countries outside their own region.

[7] Countries are classified as low income or middle income using the World Bank country classifications.

[8] The trade data used is the IMF's Direction of Trade Statistics. There are some inconsistencies in the data from sub-Saharan countries. Of the 16 middle income countries in sub-Saharan Africa, the IMF reports trade for 8 individually and for five other sub-Saharan countries in the form of the South African Customs Union (SACU), which includes South Africa, Botswana, Lesotho, Swaziland and Namibia. Because the countries in SACU report in aggregate, there is no information on trade between them. Of the 34 low income countries in sub-Saharan Africa, the IMF reports trade for 33 countries. The coverage of bilateral relationships is less complete, although it is unclear whether this is because there is no trade or because the data is missing. For instance, data for SACU records zero exports to sub-Saharan countries in 1980-1989, yet the importing sub-Saharan countries report imports from SACU. Data from sub-Saharan Africa is likely to be less accurate at the commodity level. Yeats (1990) discusses the accuracy of sub-Saharan historical data in some detail.

**Figure 3: Trade between Sub-Saharan Africa and the World, 2006**

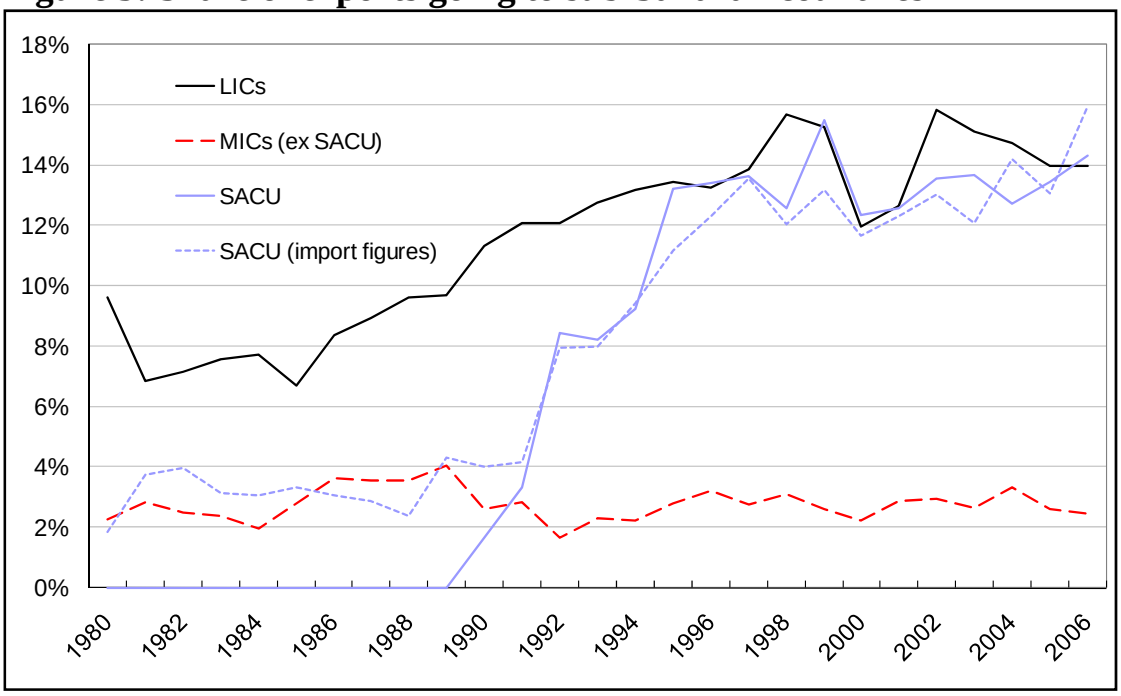



Notes: Data is sourced from the IMF's Direction of Trade statistics. Data are in US$ (current).

Sub-Saharan trade has become increasingly regionalized. The share of exports from low-income countries in the sub-Saharan region that go to other countries within the region has increased from approximately 8 per cent in the early 1980s to 14 per cent in 2006. This also appears to be true for countries in SACU.[9] Exports from other sub-Saharan middle income countries do not appear to have become more regionalized.

[9] There appears to be inaccurate reporting of exports to sub-Saharan countries by SACU. Import data from sub-Saharan Africa also supports the conclusion that SACU is now exporting more within its own region.

**Figure 5: Share of exports going to sub-Saharan countries**




Notes: South African data is available only from 1998 onwards. LIC is low-income countries, MIC is middle-income countries and SACU is the South African Customs Union. Source: IMF Direction of Trade Statistics.

## Modeling Sub-Saharan African Exports

Spillovers can occur through trade if growth in country i increases exports from country j to country i. In this section we aim to measure the extent of these spillovers and to test whether they differ for sub-Saharan African countries. Before doing this, we will discuss the gravity model that we use and the data that we use to estimate it.

## Panel Gravity Model

The gravity equation in its simplest form links bilateral trade flows ($e_{ij}$) to the size of the exporting and importing countries ($y_i$ and $y_j$) and the distance between them ($d_{ij}$ ) (equation 1). All variables are typically specified in logs.

$$e_{ij} = \beta_0 + \beta_1 . y_i + \beta_2 . y_j + \beta_3 . d_{ij} \quad (1)$$

This equation has a long and successful history in explaining bilateral trade patterns. Theory has since followed the empirical success of the gravity equation and provided the justification for the multiplicative functional form that it uses (Anderson 1979, Bergstrand 1985).

The theory behind the gravity model views distance as a proxy for bilateral trade costs. A wide variety of other variables may also affect trade costs and have since been included in the gravity equation. These include common language, common border, colonial relationships, being landlocked or an island, having access to navigable rivers or the coast and having migration linkages.

The focus on our paper is quite different. Instead of asking whether sub-Saharan Africa's trade patterns can be explained, we how they have changed through time and why. We are particularly interested in whether growth in trading partners impacts on exports. To understand this we need to embed the gravity model in a panel setting. The equation that we estimate is therefore of the form of equation 2.

$$e_{ij,t} = \beta_{ij} + \beta_1 . y_{i,t} + \beta_2 . y_{j,t} + D_t \quad (2)$$

We allow for bilateral fixed effects capturing trade between two particular countries ($\beta_{ij}$). These fixed effects may depend on all the unchanging factors cited above such as distance and historical relationships. We also allow for time variation in world trade through time dummies ($D_t$). The coefficients on own and partner country GDP are then capturing how changes in a country's GDP and changes in its trading partner's GDP impact on bilateral exports.

Setting a gravity model in a panel data setting is not new. Brun et al (2005) use a panel gravity model to test whether distance has become more or less important through time. They use a random effects estimator, which incorporates cross-section variation. This allows them to better estimate the effects of cross-section variables such as distance. We are primarily interested in growth or spillover effects and therefore use bilateral fixed effects in our main specifications.

For many country pairs there is no trade, at least for some time periods (Helpman et al 2007). We do not seek to model this selection effect. Our focus is on explaining changes in bilateral trade and we therefore include bilateral fixed effects in our main specifications. For our analysis then, by removing data that is zero or missing we are ignoring data when country pairs that have traded stop trading and when country pairs that did not trade begin trading. This is not common and we are therefore ignoring only a small amount of information (Helpman et al 2007). Our second reason for not modeling selection is that in practice, it is often difficult to distinguish between bilateral trade that is not reported and bilateral trade that is zero. This could potentially lead to large false changes in trade if we specified missing observations as zero trade. We therefore estimate our model only using positive trade relationships.

To capture changes that are specific to sub-Saharan Africa we create three dummy variables.

- SS1 is a dummy equal to one if the exporter is in sub-Saharan Africa and zero otherwise;
- SS2 is a dummy equal to one if the importer is in sub-Saharan Africa and zero otherwise; and
- SS3 is a dummy equal to one if both the exporter and the importer are in sub-Saharan Africa and zero otherwise.

Since we are using data through time, changes in prices may bias our results. We therefore use constant US$ GDP and deflate bilateral exports as discussed below.

## Data

We use merchandise export data from the IMF *Direction of Trade Statistics* for 1981 to 2005. This data is in current US$. To remove price effects we deflate nominal exports by the ratio of nominal to real GDP. In doing this we are implicitly assuming

that export prices for each country pair have the same price index as production. We also use export specific price deflators from the World Bank, calculated as the ratio of exports of goods and services in current US$ to exports of goods and services in constant US$, as a robustness check on our results.

We average bilateral export data and GDP data from 1981 to 205 over five year periods to remove volatility in export figures. This gives us five periods for our panel. For missing values, we assume the missing value is equal to the average of the values that are available, as long as there is data for at least one year. If missing bilateral data were actually zero then we would be overstating exports.

We replicate results using export data from the UN's *Comtrade Database* and using mirrored import data from both the IMF and UN as a test of robustness.

We are particularly interested in sub-Saharan Africa. Sub-Saharan trade data may be measured with more error than trade data from, for example, the US. To test for this we can compare US reported imports from Nigeria with Nigerian reported exports to the US. These would be expected to differ only due to the costs of insurance and freight included in import figures. While we often observe substantially different figures reported by each country, the correlation of bilateral exports to mirrored imports is over 0.99. The proportion of bilateral mirrored values that deviate by more than 10 per cent does not appear to be systematically higher for sub-Saharan African countries than for other countries.

## Results

Our primary interest is in two key features of sub-Saharan African trade. The first is whether the sub-Saharan regionalization observed in Figure 3 has been driven by growth in the sub-Saharan region. The second is how much growth in trading partners is likely to boost sub-Saharan exports and whether this effect is weaker or stronger when the trading partner is also a sub-Saharan country.

Since one of the main questions that we seek to answer is about the effects of growth, we focus on a specification that accounts only for variation through time. This is the fixed effects specification in Table 2.

We initially estimate the gravity equation with economic size and time period dummies, allowing for no specific sub-Saharan changes (Table 2). The main coefficient of interest, on the GDP of the partner country (Y2), is estimated as 0.84 using our preferred fixed effects estimator. This is similar to the coefficients reported in Brun et al (2005).

In Table 2 we also show results including distance and estimated using random effects, pooled OLS and only for the cross-section for 2001-05. These estimates are fairly similar to our preferred fixed effects specification. A Hausman test does reject the random effects coefficients in favour of those estimated with fixed effects, with a test statistic of 260. This reflects the large sample size that we have rather than any material difference in coefficients.

## Table 2: Panel gravity model estimation

Dependent variable: Bilateral real exports, IMF, in logs

| | Fixed effects | Random effects | Pooled OLS | 2001-2005 |
|---|---|---|---|---|
| R2 | | | | |
| -within | 0.12 | 0.12 | | |
| -between | 0.57 | 0.67 | | |
| -overall | 0.54 | 0.64 | 0.65 | 0.62 |
| No. obs. | 75792 | 75792 | 75792 | 20823 |
| *Economic size* | | | | |
| Y1 | 1.38 | 1.26 | 1.21 | 1.19 |
| | (0.05) | (0.01) | (0.00) | (0.00) |
| Y2 | 0.84 | 0.93 | 0.91 | 0.89 |
| | (0.04) | (0.01) | (0.00) | (0.00) |
| Distance | | -1.57 | -1.54 | -1.53 |
| | | (0.02) | (0.01) | (0.01) |

Notes: Y1 is log GDP of the exporting country, Y2 is log GDP of the importing country, Distance is log bilateral distance. For 2001-2005 results we use nominal exports and GDP as we do not have to worry about changes through time. Huber-White Heteroskedasticity robust standard errors are in parentheses. Period dummies are included in the regression but not reported.

The coefficient estimates on own and foreign GDP are fairly robust, even though we are only considering variation within each country pair (Table 3). The first three columns replicate the fixed effects analysis in Table 2 using export data from the UN and using mirrored import data from the UN and IMF. The fourth column uses export prices to deflate bilateral exports instead of GDP prices. The final column includes price effects. These proxy for potential real exchange rate effects and competitiveness.

## Table 3: Robustness checks

Dependent variable: Bilateral real exports, in logs

| Source | Exports, UN | Mirrored imports, IMF | Mirrored imports, UN | Exports, IMF, using export prices | Exports, IMF |
|---|---|---|---|---|---|
| Obs | 71677 | 79478 | 79322 | 67863 | 77776 |
| R2 | | | | | |
| - within | 0.12 | 0.10 | 0.10 | 0.14 | 0.13 |
| - betw. | 0.53 | 0.60 | 0.62 | 0.56 | 0.55 |
| - overall | 0.50 | 0.57 | 0.59 | 0.55 | 0.53 |
| Y1 | 1.59 | 1.18 | 1.04 | 1.11 | 1.26 |
| | (0.05) | (0.05) | (0.04) | (0.05) | (0.05) |
| Y2 | 0.68 | 0.89 | 0.98 | 0.75 | 0.77 |
| | (0.04) | (0.05) | (0.05) | (0.04) | (0.04) |
| P1 | | | | | -0.80 |
| | | | | | (0.04) |
| P2 | | | | | 0.41 |
| | | | | | (0.03) |

Notes: Y1 is log GDP of the exporting country, Y2 is log GDP of the importing country, P1 and P2 are price levels, calculated as the log of nominal GDP/real GDP. If not otherwise stated nominal trade is deflated using the GDP current to GDP constant price ratio of the exporting country. Huber-White Heteroskedasticity robust standard errors are in parentheses. Period dummies are included in the regression but not reported.

Using these specifications, the coefficient on partner country GDP varies from 0.68 to 0.98 and is always significantly different to zero. We conclude that, for a typical country pair, growth in one country leads to increased exports from the other country, after controlling for bilateral fixed factors.

Sub-Saharan African trade has not always been as regional as it now is. We can see this through the increase in the share of exports from sub-Saharan countries going to other sub-Saharan countries (Figure 5). The regionalization of sub-Saharan exports could potentially be driven by changes in output in the sub-Saharan region relative to the rest of the world. To test this we include our three sub-Saharan dummy variables interacted with time dummies. The dummy coefficients will pick up changes in the patterns of sub-Saharan trade through time, after accounting for changes in country size.

The panel model results with sub-Saharan time dummies are reported in Table 4. For ease of understanding, the time dummies are reported with each time period having its own column and each dummy having its own row. In interpreting coefficients we must remember that the time dummies capture changes in sub-Saharan exports relative to changes in world exports through time. For instance, the SS1 dummy captures the amount exported by a sub-Saharan country relative to any other exporter. A negative coefficient indicates that sub-Saharan exporters are exporting relatively less than an average country than they did in 1981-86.

The most striking feature of Table 4 is the upward trend in the SS3 coefficients. This indicates that sub-Saharan African exporters are exporting much more of their exports to other sub-Saharan African countries than they did in 1981-86. It is telling a story of regionalization. By 2001-05, sub-Saharan African countries were exporting 100 per cent more to a typical sub-Saharan country than to a non-sub-Saharan country than they did in 1981-85, after accounting for changes in country size.

## Table 4: Changes in sub-Saharan trade through time

| Dependent variable: Bilateral real exports, IMF | | | | |
|---|---|---|---|---|
| Obs. | 77913 | | | |
| Y1 | 1.30 | | | |
| | 0.77 | | | |
| Y2 | 0.77 | | | |
| | 0.04 | | | |
| | | | | |
| | 1986-1990 | 1991-1995 | 1996-2000 | 2001-2005 |
| SS1 | -0.12 | 0.06 | 0.03 | -0.15 |
| | (0.08) | (0.08) | (0.07) | (0.08) |
| SS2 | -0.20 | -0.29 | -0.41 | -0.28 |
| | (0.06) | (0.06) | (0.06) | (0.06) |
| SS3 | 0.36 | 0.74 | 0.83 | 1.00 |
| | (0.15) | (0.15) | (0.14) | (0.15) |

Notes: Fixed effects estimator applied to each country pair. Y1 is log GDP of the exporting country, Y2 is log GDP of the importing country, SS1 SS2 and SS3 are sub-Saharan dummies explained in the text. Huber-White Heteroskedasticity robust standard errors are in parentheses. Period dummies are included in the regression but not reported.

These changes in the pattern of sub-Saharan African trade also emerge if we estimated cross-section regressions for each of our five-year periods and include sub-Saharan dummies (Table 5). We observe that sub-Saharan countries exported about as much to sub-Saharan countries as non-sub-Saharan countries in 1981-86, after accounting for economic size and distance. By 2001-06, they exported 93 percent more to a sub-Saharan country than to a non-sub-Saharan country, after accounting for economic size and distance.

In cross-section regressions we can also test whether a typical trade relationships involving sub-Saharan countries is different to a typical trade relationship not involving sub-Saharan countries, after accounting for economic size and distance between the countries. The negative coefficient on SS1 suggests that sub-Saharan African countries exported less to countries outside their region, on average, than would be expected. They have in some periods also imported less than expected as well, with the coefficient on SS2 often being negative.

If we add up the coefficients on SS1, SS2 and SS3 we are comparing typical trade between two sub-Saharan African countries against typical trade between any two non-sub-Saharan countries. We find that the sub-Saharan country pair traded less than a non-sub-Saharan pair in 1981-1985. But by 2001-05 sub-Saharan country pairs were trading 46 per cent more than a non-sub-Saharan pair, after accounting for economic size and distance.

We document the regionalization of sub-Saharan African trade as an empirical fact but do not seek to explain it. We note that there are a host of regional agreements within sub-Saharan Africa that could potentially have played a role in these changes. Later in the paper we test whether the patterns we observe for 2001-2005 can be explained by country characteristics and country-pair characteristics.

## Table 5: Cross-section estimation of the gravity equation

| Dependent variable: Bilateral real exports, IMF | | | | | |
|---|---|---|---|---|---|
| | 1981-5 | 1986-90 | 1991-5 | 1996-2000 | 2001-5 |
| R2 | 0.63 | 0.64 | 0.65 | 0.65 | 0.65 |
| No. obs. | 9086 | 11426 | 15924 | 19526 | 19830 |
| Y1 | 1.12 | 1.16 | 1.19 | 1.22 | 1.26 |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| Y2 | 0.84 | 0.88 | 0.89 | 0.91 | 0.96 |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| Dist. | -1.43 | -1.54 | -1.48 | -1.51 | -1.53 |
| | (0.03) | (0.03) | (0.02) | (0.02) | (0.02) |
| *Sub-Saharan effects* | | | | | |
| SS1 | -0.32 | -0.41 | -0.20 | -0.18 | -0.46 |
| | (0.09) | (0.08) | (0.07) | (0.06) | (0.07) |
| SS2 | -0.03 | -0.15 | -0.16 | -0.19 | -0.02 |
| | (0.07) | (0.06) | (0.06) | (0.05) | (0.05) |
| SS3 | 0.08 | 0.11 | 0.48 | 0.58 | 0.93 |
| | (0.17) | (0.15) | (0.13) | (0.11) | (0.13) |
| Intra-sub-Saharan trade relative to average relationship | -0.27 | -0.45 | 0.13 | 0.22 | 0.46 |

Notes: Y1 is log GDP of the exporting country, Y2 is log GDP of the importing country, Dist is log bilateral distance and SS1, SS2 and SS3 are as explained in text. Huber-White Heteroskedasticity robust standard errors are in parentheses.

## Has Growth in Sub-Saharan Africa had Export Spillovers?

Growth in a trading partner will have the largest impact on a country's exports if they trade a lot and if trading partner growth increases demand for the country's exports. For a typical country pair we have shown that one per cent growth in a trading partner increases bilateral exports by about 0.8 per cent. We can calculate intra-sub-Saharan spillovers based on the assumption that this coefficient will also apply to growth in sub-Saharan Africa.

Take Mali as an example. In 2006, it exported 14 per cent of its exports to sub-Saharan Africa. If the rest of sub-Saharan Africa grew by 10 per cent then Mali could expect its exports to increase by 1.1 per cent (10 per cent growth * 14 per cent export share * 0.8 growth spillover coefficient), holding GDP constant in the rest of the world.

But there may be reasons to expect that sub-Saharan African countries may benefit more or less from growth in their neighbours than a typical country pair. They may benefit less because income growth may lead to demand for products that are supplied from countries outside the region, such as capital machinery, computing equipment or mobile phones. Or they may benefit more if income growth leads to agglomeration effects that shift entire industries to sub-Saharan Africa to take advantage of demand in the region.

Our results suggest that the sub-Saharan countries benefit less from growth in their region than a typical country pair (Table 6). We restrict our sample to intra-sub-Saharan bilateral trade and include country pair fixed effects as we have done earlier. We are therefore replicating the fixed effects results of Table 2 with a restricted sample. Using export data from the IMF, an increase in GDP of one per cent in a sub-Saharan country increases exports from other sub-Saharan trading partners by only 0.23 per cent. This compares to the coefficient for a typical country pair of 0.8.

We test the robustness of this result using export and mirrored import data from the UN and IMF and using real exports calculated with export prices. Using this data, export spillovers in sub-Saharan Africa are typically smaller than we calculated using these methods and the full set of bilateral trade relationships, although not significantly smaller as we found using IMF data. For none of the methods do we find any evidence that trade spillovers between sub-Saharan countries are greater than for a typical country pair.

## Table 6: Spillovers specific to sub-Saharan Africa

| | Real exports, IMF | Real exports using export prices, IMF | Real exports, UN | Mirrored real imports, IMF | Mirrored real imports, UN |
|---|---|---|---|---|---|
| Obs | 4149 | 3733 | 3697 | 4453 | 4309 |
| R2 | | | | | |
| Within | 0.12 | 0.13 | 0.12 | 0.11 | 0.08 |
| Between | 0.17 | 0.17 | 0.15 | 0.17 | 0.21 |
| Overall | 0.14 | 0.14 | 0.14 | 0.13 | 0.17 |
| | | | | | |
| Y1 | 1.34 | 0.92 | 1.51 | 0.62 | 0.89 |
| | (0.27) | (0.27) | (0.35) | (0.20) | (0.22) |
| Y2 | 0.23 | 0.26 | 0.70 | 0.81 | 0.84 |
| | (0.19) | (0.20) | (0.20) | (0.22) | (0.35) |

Notes: Y1 is log GDP of the exporting country, Y2 is log GDP of the importing country. Huber-White Heteroskedasticity robust standard errors are in parentheses. Period dummies are included in the regression but not reported.

### Logistics costs and country pair fixed effects

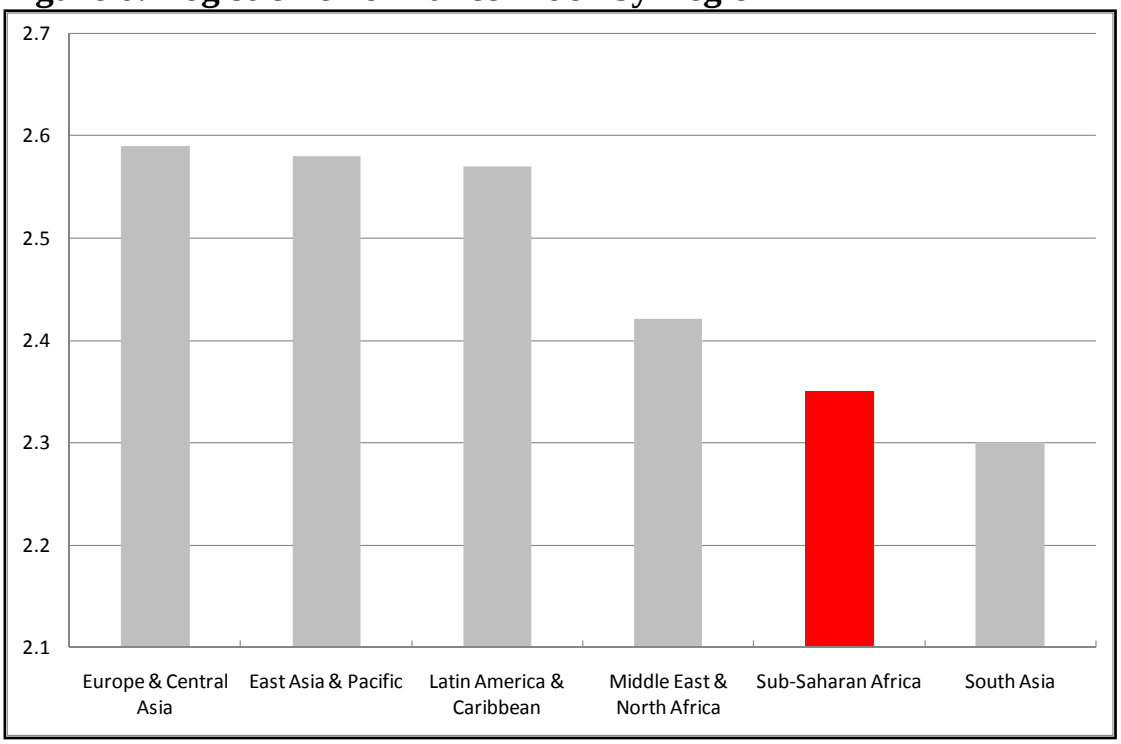
The discussion above has focused on the impact of economic growth in neighbouring countries on exports and on changes in sub-Saharan trade patterns through time. Because of this, we specified fixed effects for each country pair. However, these country specific effects are clearly of independent interest in understanding the level of trade between two countries.

Many country characteristics have been identified as helping or hindering trade in cross-section regressions. For instance, good internal geography such as access to rivers or the coast tends to increase trade. Bilateral characteristics are also important. Countries that share a common language, a common border or a common history are likely to trade more with each other. Many of these features are not subject to change and cannot be affected by policy.

In this section we test the impact of logistics on trade. Poor logistics would be expected to increase trade costs and reduce trade. Sub-Saharan African countries tend to perform poorly in an index of logistics performance released by the World Bank (Arvis et al 2007). This index captures time costs, logistic competence, domestic transport costs, international shipping costs, customs efficiency and infrastructure quality. It is based on perceptions of logistics operators and data on logistics costs. The index is a score out of five. The best performer according to this index is Singapore with a score of 4.19 while the worst is Afghanistan with a score of 1.21. The standard deviation for the 150 countries covered is 0.6.

Sub-Saharan Africa's logistics performance is lower than all other regions except South Asia (Figure 6). This partly reflects the positive correlation between income and logistics performance. It may also reflect country characteristics that make logistics more difficult. But the logistics index also contains information that can be used for policy – country logistics performance can be changed.

**Figure 6: Logistic Performance Index by Region**




Notes: The Logistics Performance Index is a score out of five. Source: Arvis et al (2007).

We test whether logistics has an independent impact on trade, above and beyond the impact that internal geography and income have on logistics. We use cross-section variation to estimate the impact of the logistics index using export data averaged over the period 2001-05. It is not possible to consider the impact of changes in logistics using the logistics index that we have because it is only available for one time period. We put in controls for internal geography, common language (both ethnic and official), common border and current and past colonial relationships.

We find that logistics, as captured by the Logistics Performance Index, has an independent and economically significant effect on exports (Table 7). A one standard deviation increase in logistics performance increases exports by approximately 60 per cent.

Improved trading partner logistics is an alternative trade spillover to improved economic size. If neighbours improve their logistics then this is likely to increase exports. Our estimation shows that these effects can be large. If a trading partner improves their logistics by one standard deviation then this could increase exports to that country by 25 per cent.

Logistics performance and the control variables that we have included in our cross-section regression do not explain our findings on sub-Saharan exports patterns. After accounting for these control, sub-Saharan exporters typically export less to the rest of the world than we would expect and more to other sub-Saharan countries than to countries outside their region.

## Table 7: Logistics and Exports

| Dependent variable: Bilateral nominal exports, IMF | | |
|---|---|---|
| Obs | 14464 | 14464 |
| R2 | 0.7031 | 0.71 |
| Y1 | 1.07 | 1.00 |
| | (0.02) | (0.02) |
| Y2 | 0.83 | 0.86 |
| | (0.02) | (0.02) |
| Dist | -1.40 | -1.37 |
| | (0.03) | (0.03) |
| Logistics 1 | 0.99 | 1.09 |
| | (0.05) | (0.05) |
| Logistics 2 | 0.47 | 0.43 |
| | (0.05) | (0.05) |
| SS1 | | -0.67 |
| | | (0.08) |
| SS2 | | 0.12 |
| | | (0.06) |
| SS3 | | 0.56 |
| | | (0.14) |

Notes: Y1 is log nominal GDP of the exporting country, Y2 is log nominal GDP of the importing country, SS1,SS2 and SS3 are as detailed in text, Logistics 1 and Logistics 2 are the Logistics Performance Index for the exporting and importing country respectively. Country characteristics included but not reported are (for both exporter and importer) the proportion of people within 100 kilometers of a navigable river or the coast, being landlocked, being an island and internal area. Bilateral characteristic included but not reported are sharing a border, sharing an official or minor language, being a colony or past colony, having a common colonizer and being the same country in the past. Huber-White Heteroskedasticity robust standard errors are in parentheses.

It is possible that the logistics and exports interact in a more complicated way than implicitly assumed above. If there are economies of scale in exporting then greater exports may improve logistics performance. Since we are using cross-section data it is also possible that unobserved country specific factors drive both logistics performance and exports. We minimize this issue through using an extensive set of controls.

## Discussion and Conclusions

We find that the economic distance of a typical person in sub-Saharan Africa is further from world markets than people in most other regions. They have moved slightly further from world markets since 1980. At the same time, export growth in sub-Saharan Africa has generally been much slower than export growth in the world.

We also document a regionalization pattern in sub-Saharan exports. More of sub-Saharan Africa's exports are now staying within the region. Using a panel gravity model with country pair fixed effects effects, we show that this is not due to changes in economic size. We do not explore the reasons behind this regionalisation further, although we note that the proliferation of regional integration agreements provides one possible area for future analysis.

While growth has not driven the regionalization process in Africa, trading partner growth does increase exports. For a typical pair of countries, a one per cent increase in trading partner growth increases exports by 0.8 per cent. In sub-Saharan Africa this effect may be weaker. IMF data suggests intra-African export spillovers of only 0.23 per cent. We find that intra-African spillovers are unlikely to be larger than the spillovers for a typical country pair, using alternative data sources, but cannot reject that intra-African spillovers are the same as a typical country pair.

Growth in trading partners is the clearest example of spillovers through exports. But we also find that the logistics of trading partners is an important determinant of trade. While we can only base our estimates on cross-section data, if these estimates are correct, then a one standard deviation improvement in the logistics of a trading partner would boost exports to that trading partner by about 25 per cent. Improving your own logistics by the same amount has an even larger effect, increasing exports by 60 per cent.

## References

Anderson, J. (1979) "A Theoretical Foundation for the Gravity Equation", *The American Economic Review*, Vol. 69, No. 1., pp. 106-116.

Anderson, J.E. and E. van Wincoop (2004), "Trade costs", *NBER Working Papers*, No. 10480, May.

Anderson, J.E. and E. van Wincoop (2001), "Gravity with Gravitas: a Solution to the Border Puzzle", *NBER Working Papers*, No. 8079, January.

Arvis, J-F., M. Mustra, J. Panzer, L. Ojala and T. Naula (2007), *Connecting to Compete: Trade logistics in the global economy*, World Bank: Washington.

Bergstrand. J. (1985). "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence", *The Review of Economics and Statistics*, Vol. 67, No. 3., pp. 474-481.

Brun, J., C. Carrere, P. Guillaumont and J. de Melo (2005), "Has Distance Died? Evidence from a Panel Gravity Model", *World Bank Economic Review*, Vol. 19, No. 1, pp 99-120.

Coe, D. and A Hoffmaister (1999), "North-South Trade: Is Africa Unusual", *Journal of African Economies*, Vol. 8, No. 2, pp228-256.

Foroutan, F. and L. Pritchett (1993), "Intra-sub-Saharan African trade: Is it too little?" *Journal of African Economies*, Vol. 2 No. 1, pp74-105.

Helpman, E., M. Melitz and Y. Rubinstein (2007), "Estimating trade flows: Trading partners and trading volumes", *NBER Working Papers*, No. 12927, February.

IMF (2007), *World Economic Outlook: Globalisation and inequality*, Wahington: IMF, October.

Javorcik, B. (2004), "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages", *The American Economic Review*, Vol. 94, No. 3, pp. 605-627.

Keller, W. (2002), "Geographic localization of international technology diffusion", *American Economic Review*, Vol. 92, No. 1. (Mar., 2002), pp. 120-142.

Loungani, P., A. Mody and A. Razin (2002), "The Global Disconnect: The role of transactional distance and scale economies in gravity equations", *Scottish Journal of Political Economy*, Vol. 49, No. 5, pp 526-543 , November.

Overman, H., S. Redding and A. Venables (2003), "The Economic Geography of Trade, Production and Income: A survey of empirics", London: LSE Research Online.

Portes, R. and H. Rey (2005), "The determinants of cross-border equity transaction flows", *Journal of International Economics*, Vol. 65, pp. 269-296.

Rauch, J. and V. Trindale (2002), "Ethnic Chinese networks in international trade", *Review of Economics and Statistics*, Vol. 84, pp116-130.

Redding, S. and A.J. Venables (2003), "Geography and Export Performance: External market access and internal supply capacity", *CEPR Discussion Paper Series,* No. 3807, February.

Rodrik, D. (1998), "Trade Policy and Economic Performance in Sub-Saharan Africa", *NBER Working Papers,* No. 6562, May.

World Bank (2007), *African Development Indicators*, Washington: World Bank.

Yeats, A. (1990), "On the Accuracy of Economic Observations: Do Sub-Saharan Trade Statistics Mean Anything?", *The World Bank Economic Review*, Vol. 4, No. 2, pp135-156.