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Regional Growth Spillovers in Sub-Saharan Africa

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Regional Growth Spillovers in Sub-Saharan Africa[1]

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Abstract

This paper documents the steady increase in intraregional trade in sub-Saharan Africa since 1980, links this rise to important growth spillovers in the region, and identifies the main source countries and those most vulnerable to the economic conditions of others. Estimates show that positive idiosyncratic shocks to regional trading partners' growth significantly increase growth in the average sub-Saharan African country by 0.2-0.5 percent. Policy implications including the need to support further continent-wide integration and the associated growth spillovers are discussed. Actions policymakers in sub-Saharan Africa can take to capture the benefits of these spillovers, while limiting exposure to the associated risks, are also proposed.

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Contents

I. INTRODUCTION

After close to two decades of strong economic activity, growth in sub-Saharan Africa decelerated markedly from 2015–16, to its lowest level in more than 20 years at 1.4 percent in 2016. Nonetheless, this average mask substantial heterogeneity across the region. While the largest economies (i.e., Nigeria and South Africa) experienced negative or very low growth, a third of countries in the region continued to grow at 5 percent or more during the period. While these trends have been well documented, little is known about how they are interlinked.

This paper attempts to shed light on this question and fill a gap in the literature that has largely overlooked integration and its implications *within* sub-Saharan Africa. Namely, we ask how has intraregional integration evolved in sub-Saharan Africa in recent decades and how has this affected growth spillovers on the continent? We focus on trade linkages, which are the strongest in the region (Arizala et al., 2018). We first present a novel set of stylized facts that document that intraregional integration in sub-Saharan Africa is significantly greater than is widely believed and is indeed inline or greater than in developing and emerging economies in other regions. With this, we identify the countries in sub-Saharan Africa that are more likely to generate regional growth spillovers through trade, as well as the countries that are more likely to suffer from growth spillovers from their regional trading partners. We then estimate and quantify growth spillovers between trading partners in sub-Saharan Africa.

The growth spillover literature is broadly based on the idea that domestic growth in any country is determined by three main drivers: domestic shocks, global shocks, and shocks to a foreign country or region(s) that are transmitted through various channels to the domestic country (Furceri, Jalles, and Zdzienicka (2016), Doyle and Faust (2005)). While evidence on the comparative importance of each driver varies, it is widely accepted that growth co-moves across countries in the long term in countries who have large bi-lateral trade flows or coordinated fiscal policy, and especially in advanced economies (Frankel and Rose (1998); Doyle and Faust (2005); Sly and Weber (2013); Arora and Vamvakidies (2005a); Dabla-Norris, Espinoza, and Jahan (2015)). The presence of growth spillovers in the shorter-term within and between low income and emerging market countries has also been documented (Samake and Yang (2011); Barrot, Calderón, and Servén (2018), and Almansour and others (2015)). And Blongigen, Piger, and Sly (2014) bridge the gap between these literatures and show that shocks to long-term growth (trend growth) have larger cross-country spillovers than shocks to short-term growth (cyclical growth).

Yet, whether longer term growth spillovers exist within groups of low-income countries, particularly in sub-Saharan Africa, is less evident. Indeed, it could be argued, *a priori,* that given the nature of their trade relationships and the structure of their economies, these countries may experience growth spillovers differently than advanced or emerging countries. Structural barriers to regional spillovers in these countries may include their position in global value chains, the absence of widespread multinationals, their reliance on imports for most consumption goods and their historically limited regional integration.

Indeed, much of the literature on growth spillovers in sub-Saharan Africa has focused on spillovers emanating from outside the region and found mixed results. Raddatz (2007), looking at levels, found little impact of any foreign shock on GDP per capita in sub-Saharan Africa. His findings have been linked to the absence of interregional infrastructure and to the presence of resource-poor landlocked countries, among other factors (Roberts and Deichmann, 2011, Bonfatti and Poelhekk, 2017, and Collier and O'Connel, 2007). Others find that the region is highly vulnerable to external shock spillovers (Drummond and Ramirez, 2009) and that external shocks are important for stability (Raddatz, 2008). With the advent of Chinese foreign investment on the continent in recent decades, there is also evidence of large growth spillovers specifically between China and sub-Saharan African countries (Mullings and Mahabir, 2018, Chen and Nord, 2017).

Our work instead focuses on intraregional spillovers, which have received limited attention in the literature. Existing studies have found that intraregional growth spillovers are relatively large but may operate mainly through their ability to connect sub-Saharan African countries to international markets, and thus increase demand for their exports (Easterly and Levine, 1998; Moore, 2018). Evidence of spillover within sub-regions of sub-Saharan Africa is similarly mixed – Canales-Kriljenko, Gwenhamo, and Thomas (2013) find that growth spillovers are particularly strong from South Africa to smaller countries in the SACU, while Basdevant and others (2015) do not find evidence of growth spillovers from South Africa to the rest of the continent.

In the first part of our analysis, we estimate spillovers using the local projections model developed by Jorda (2005) and adapting an identification method proposed by Furceri, Jalles, and Zdzienicka (2016). Next, we build on a line of work that estimates long-term growth spillovers in a panel fixed-effect model, based on the degree of interconnectedness between countries or regions (Arora and Vamvakidies (2005a), Dabla-Norris, Espinoza, and Jahan (2015)).

Our main finding is that growth spillovers in sub-Saharan African countries are important: using a local projections model, we see idiosyncratic shocks to individual sub-Saharan African countries are found to have statistically significant an economically large impact on other sub-Saharan African countries output. Quantitatively, we find that a 1 percent shock in average growth of trading partners is associated with an increase of about 0.5 percent in output of the average sub-Saharan Africa country four years after the shock. Using the panel fixed effects model, we find quantitatively similar spillovers, estimating that a 1 percentage point increase in the export-weighted growth rate of intra-regional partners is associated with about 0.35 percent increase in the average sub-Saharan African country growth. This result is robust to accounting for extra-regional factors that have been shown to drive growth in sub-Saharan Africa, such as global growth and demand from large trading partners including China, whose increased importance for sub-Saharan African exports has been shown to be an important driver of growth in the region (Chen and Nord, 2017), and to various alternative model specifications. Consistent with having comparable shares of intra-regional trade to emerging and developing economies in other regions, we then show that long-run growth spillovers in sub-Saharan Africa are of similar magnitude to those in other emerging and developing economies.

Our results stress the growing importance for policymakers to factor-in spillovers from within the region when planning for the medium term, and to design growth-friendly policies that addresses increasing transmission risks. In addition, it highlights the need in sub-Saharan Africa for an emphasis on regional surveillance and spillover analysis alongside traditional bilateral surveillance.

The rest of the paper is organized as follows. The next section presents new facts on intraregional integration in sub-Saharan Africa. Section III discusses the data and the empirical strategy used in our analysis. Section IV presents the results from investigating the size of intraregional growth spillovers. Section V concludes.

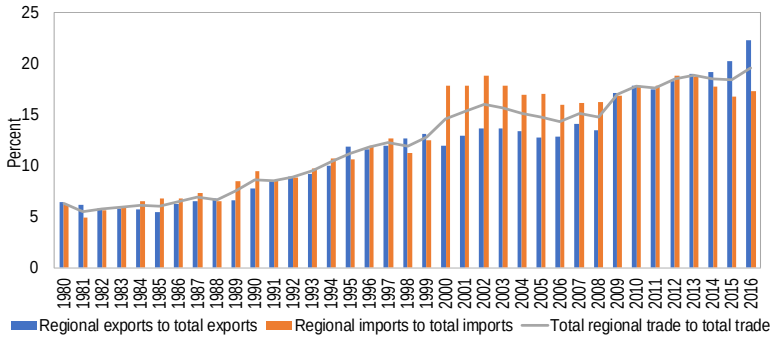
II. STYLIZED FACTS

A. Intraregional Trade Linkages are Steadily Gaining Strength

Though often thought of as silos that are linked to the rest of the world but not each other, sub-Saharan African economies have become much more intertwined in the last 35 years. This trend is particularly well illustrated by the increase in regional trade as a share of total trade, which represented 6 percent in 1980 before taking-off in the early 1990s, and eventually reaching 20 percent in 2016 (Figure 1). This increase in regional trade was significant relative to the size of sub-Saharan African economies, and it was faster for small countries in the region, as reflected by the faster growth in the simple average level of trade integration (Figure 2).

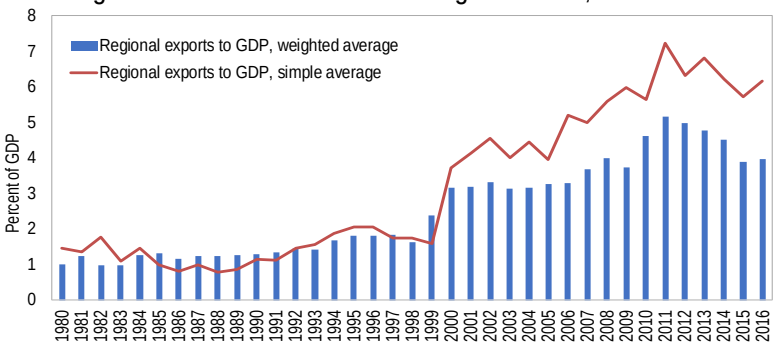
Tighter regional trade integration, which coincided with a rise in global integration, is the result of both global developments and of a strengthening of institutional and macroeconomic conditions in the region. The rise in trade with the rest of the World was driven in part by a two-fold increase in the relative price of commodity exports over the period 1995–2013 and in part by a rise of two and a half times in volume of exported commodities (Allard and others, 2016). In addition to these supporting conditions, countries in sub-Saharan Africa substantially strengthened their macroeconomic policies and political and economic institutions over the last 20 years, and experienced abating of internal and external conflicts. These elements all contributed to improving the business environment, which lead to faster growth than in the rest of the World and thereby supported the deepening of regional trade (IMF, 2015). Furthermore, the establishment of regional trade agreements in different sub-regions also contributed to regional and bilateral reductions in tariffs which further supported regional trade integration (ODI, 2010).

Figure 1. Sub-Saharan Africa: Intra-Regional Trade, 1980–2016



Sources: IMF, Direction of Trade Statistics database; IMF, World Economic Outlook database, and IMF staff calculations.

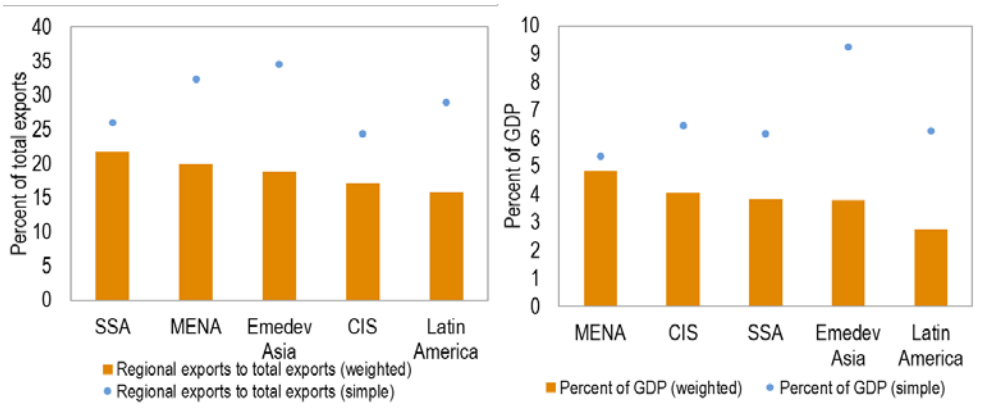
Figure 2. Sub-Saharan Africa: Intraregional Trade, 1980–2016



Sources: IMF, Direction of Trade Statistics database; IMF, World Economic Outlook database, and IMF staff calculations.
Note: Calculation based on weighted averages in each year unless otherwise indicated. The number of reporting countries varies over time but using a balanced sample reflects similar trends as the ones shown here and is available upon request.

The average level of regional trade integration in sub-Saharan Africa, and hence the potential for regional spillovers, is broadly in line with other developing and emerging market economies in other regions (Figure 3). Measured as a share of total exports, sub-Saharan Africa exhibits the highest share of intra-regional trade integration among emerging and developing economics, followed by Middle-East and North Africa and emerging and developing Asia. Relative to the size of the economy, sub-Saharan Africa is in the middle of the pack.

Figure 3. Intra-Regional Exports by Region, 2016

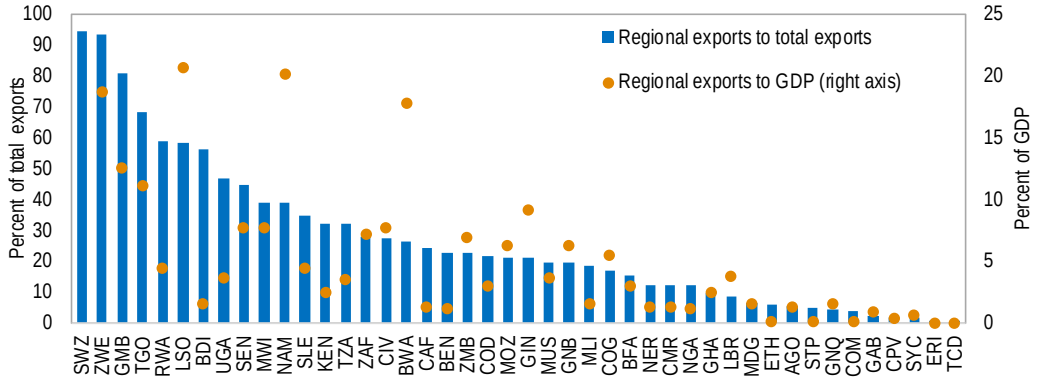


Sources: IMF, Direction of Trade Statistics database; IMF, World Economic Outlook database, and IMF staff calculations. Every region only includes emerging and developing economies, meaning that trade with any advanced economies was counted as extraregional trade.

Many sub-Saharan Africa countries are highly integrated to other countries in the region, as measured by intra-regional trade, and integration is particularly strong within sub-regions. For example, in small and very open economies in the SACU and the Economic Community of West African States (ECOWAS), like Swaziland, Lesotho, Togo and The Gambia, intra-regional exports represent more than 65 percent of these countries' total global exports (IMF, 2012) (Figure 4 and 5). In many countries intra-regional exports are also large relative to the size of the economy. This is the case for certain countries in the Southern African Development Community (SADC) (Zimbabwe, Botswana, Lesotho, and Namibia) where intra-regional exports represent about 20 percent of GDP, and some Western Africa Economic and Monetary Union (WAEMU) countries (Côte d'Ivoire, Guinea, Senegal), where they constitute close to 10 percent of GDP.[2]

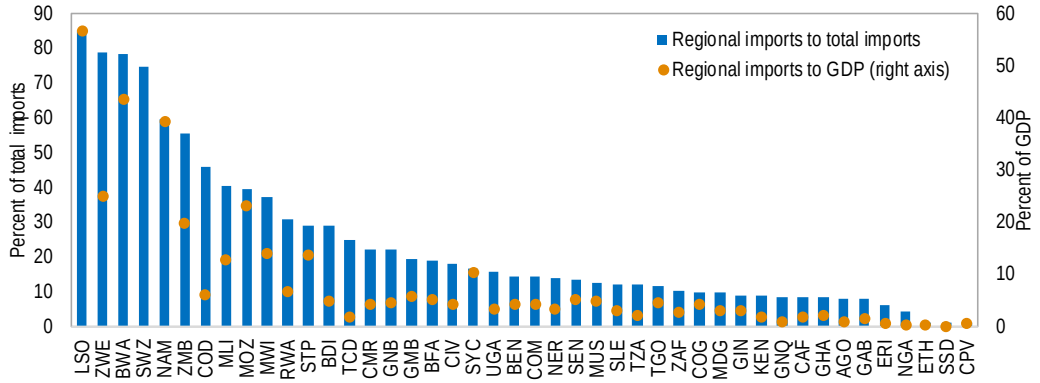
[2] Intra-regional trade can be driven by regulatory and geographic constraints to some extent. For example, Zimbabwe exports gold only to South Africa because South Africa has the only refinery that is accredited by the London Bullion Market Association. Also, exports from landlocked countries that cannot be shipped by air must go through other countries and will be accounted in intra-regional trade. The lack of data on re-exports prevents us to quantify the importance of this type of trade. Nevertheless, irrespective of the motives underpinning intra-regional trade, economic developments in transit countries are still expected to impact exporters. Furthermore, we account for geography and other country fixed effects in our econometric approach.

Figure 4. Sub-Saharan Africa Intra-Regional Exports, 2016



Sources: IMF, Direction of Trade Statistics database; IMF, World Economic Outlook database, and IMF staff calculations.
Note: Swaziland's exports to GDP ratio is not depicted, and is equal to 62 percent in 2016.

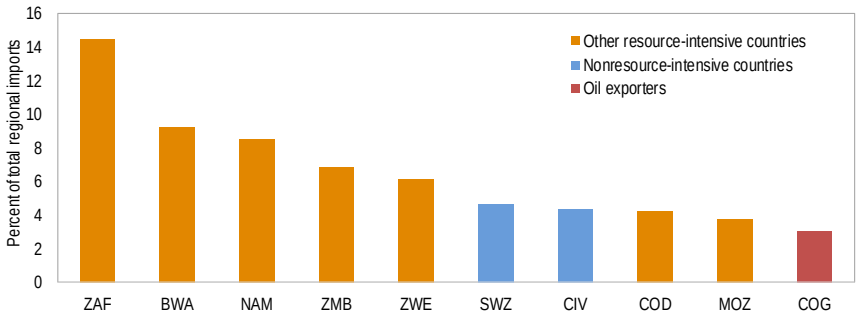
Figure 5. Sub-Saharan Africa Intra-Regional Imports, 2016



Sources: IMF, Direction of Trade Statistics database; IMF, World Economic Outlook database, and IMF staff calculations.
Note: Swaziland's imports to GDP ratio is not depicted, and is equal to 81 percent in 2016.

One can also see a concentration of integration from the opposite perspective: demand for regional exports is concentrated in very few countries. Ten sub-Saharan countries represent 65 percent of total regional demand for intra-regional exports, with South Africa, Botswana and Namibia accounting for the largest shares of total regional demand, and South Africa alone importing 15 percent of total regional exports (Figure 6). When countries trade significantly among themselves an economic deceleration in any one country has the potential to weaken demand for intra-regional exports and may constitute a source of wider negative spillovers.

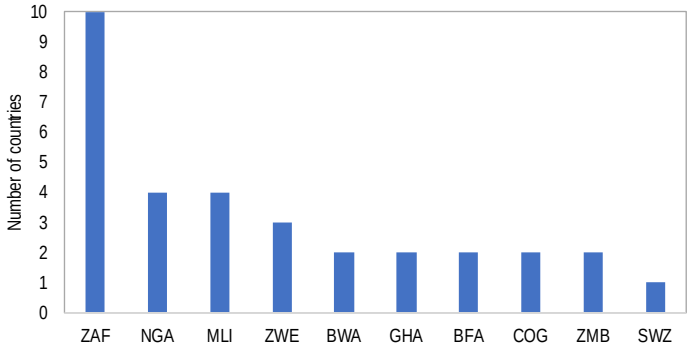
Figure 6. Sub-Saharan Africa: Share of Intra-Regional Imports, 2016



Sources: IMF, Direction of Trade Statistics database; and IMF staff calculations.

The value of the regional imports purchased by the top 10 regional importers (*i.e.* those listed in Figure 6) represents significant shares of the economies of the exporting countries, setting the stage for potentially large spillovers. For instance, South African imports from Swaziland, Lesotho, Zimbabwe and Mozambique represent between 4 and 11 percent of these economies' GDP. Zimbabwe's total demand for goods from Zambia, Malawi and Botswana constitutes between 1 and 4 percent of these countries' GDP. Other countries also import in amounts that are non-negligible shares of their neighbors' GDP, even though they do not constitute substantial shares of total sub-Saharan African intra-regional imports. This is the case of Nigeria, Mali, Ghana, and Burkina Faso, who's imports amount to more than 1 percent of GDP of their sub-regional trading partners (Figure 7). In these cases, any reduction in import demand, caused by an economic downturn in the importing country, could have significant consequences for GDP growth in their trading partners.

Figure 7. Countries with Substantial Trading Relationships from the Perspective of the Exporter



Sources: IMF, Direction of Trade Statistics database; and IMF staff calculations.
Note: Number of countries for which the country is a destination market representing more than 1 percent of GDP of the sender's economy.

We estimate gravity equations to illustrate and quantify the above stylized facts on regional integration (see Annex I). As expected, empirical estimates suggest that trade in the region is larger between closer countries (culturally and geographically) and that regional trade growth over the last four decades was supported by favorable macro-conditions (proxied by GDP per

capita and population growth). When we modify the standard equation to perform cross-region comparisons, we find that distance is a greater barrier to trade in sub-Saharan Africa, possibly because of the well-known infrastructure gaps in the region (Allard and others, 2016). Results also show that sub-regional trade agreements played a major role in strengthening bilateral trade in the region, in particular in the cases of the SADC and the EAC.

III. DATA AND EMPIRICAL METHODOLOGY

The basis of our empirical work is a weighting scheme we construct to capture the relative importance of each country's trading partner within the region. We use annual bilateral data from the IMF's Direction of Trade Statistics to build the index, which covers 45 countries in sub-Saharan Africa over the period 1980-2016. Specifically, we construct the country-pair specific weight as:

$$W_{ijt} = \frac{X_{ijt} + X_{ijt-1} + X_{ijt-2}}{\sum_j^J X_{ijt} + \sum_j^J X_{ijt-1} + \sum_j^J X_{ijt-2}} \qquad (1)$$

where W_{ijt} is the share of country *i* exports to country *j* over the years *t, t-1* and *t-2* (X_{ijt}) as a share of total regional (sub-Saharan African) exports of country *i* over the same years ($\sum_i^I X_{jit} + \sum_j^J X_{ijt-1} + \sum_j^J X_{ijt-2}$). The logic in defining the weight in such a way is that a country's exports to the region will reflect regional demand for the country's exports, which is likely to impact GDP growth in that country. We chose to use export shares over 2-year periods to smooth outlier years. We construct an analogous index for trading partners outside the region, which is used as control variable in our analysis.

A. Estimating Growth Spillovers with the Local Projections Method

We first study growth spillover in sub-Saharan Africa using Jorda's (2005) local projections method. The approach we take modifies the method proposed by Furceri, Jalles, and Zdzienicak (2017) to a panel framework. Specifically, we first identify country-specific idiosyncratic shocks to growth for sub-Saharan Africa countries and then estimate the impact of these shocks on output in other sub-Saharan Africa countries.

We define idiosyncratic growth shocks for each country in each year as deviations from world average growth over the period for that country and for all countries in the sample, following IMF (2013) and Morgan and others (2004):

$$g_{it} = \alpha_t + \gamma_i + \epsilon_{it} \qquad (2)$$

Where g_{it} is the annual rate of growth of real GDP in country *i* for year *t*, γ_i are country fixed effects, and α_t are time fixed effects. The residual ϵ_{it} is the idiosyncratic shock to growth for country *i* in year *t.* Identifying shocks this way allows us to isolate spillovers from country-specific shocks to those that affect all countries, in contrast to the more common GVAR analysis which doesn't allow for this. As noted by Furceri, Jalles and Zdzienicak (2017) though, the cost of this method is an inability to identify shocks that are purely

domestic idiosyncratic shocks from those that are domestic and immediately transmitted to other countries. While a shortcoming of this method, the benefit is that the results will be a lower bound estimate of the impact of the shocks. In a robustness exercise we also estimate (2) restricting the sample to only sub-Saharan Africa countries, thereby restricting the common shocks to sub-Saharan African shocks and the country-specific shocks to those that do not affect the region.

We then take these idiosyncratic shocks and estimate their impact on output over *K* horizons:

$$y_{i,t+k} - y_{i,t-1} = a_i + \rho^k \varepsilon_{it} + \delta(L) g_{it} + u_{it} \qquad (3)$$

Where $y_{i,t}$ is the log of real GDP (and thus $\Delta y_{i,t} = g_{it}$) and we define $\varepsilon_{it} = \sum_{j \neq i}^{J} W_{ijt-1} \epsilon_{jt}$ for all $j \neq i \in SSA$, where W_{ijt} is the bilateral weight of exports from country i to country j as a share of total country *i* exports to sub-Saharan Africa, as defined in (1), and we use its first lag to control for endogeneity. That is, ε_{it} is the export-weighted average growth shock of all of country *i*"s trading partners in sub-Saharan Africa. We set the horizon, *K*, to eight years which allows us to observe the dynamics over a sufficiently long period of time. We estimate several alternative models to confirm the robustness of this initial result and to examine country-specific shocks. First, we exclude those countries whose average nominal GDP over the sample period is in top decile of all sub-Saharan Africa countries, which includes Angola, Democratic Republic of the Congo, Kenya, Nigeria, South Africa, to ensure our results are not driven by these large economies having an outsized effect on the rest of the continent. Second, we look at the impact of a growth shock to South Africa alone, which as the largest single importer of regional exports is likely to generate the largest regional spillovers. The coefficient ρ_i^k , which is the estimated impact of a one percent change in the (weighted-average) idiosyncratic shock at each time horizon *k=0,..,8,* is our coefficient of interest. Two lags of GDP growth are included to capture persistence in growth dynamics, and control for other factors that influencing output.

B. Estimating Growth Spillovers via Panel Fixed Effects

In the second part of our analysis we estimate a panel fixed effects model to study the elasticity of GDP growth in sub-Saharan African countries to the growth of the trading partners in the region. Our method follows Arora and Vamvakidies (2005a) and Dabla-Norris, Espinoza, and Jahan (2015), and is specified as follows:

$$g_{it} = \alpha + \gamma_i + \sum_{l=1}^{L} \beta_j g_{i,t-l} + \beta_3 TPG_{it}^{SSA} + \beta_4 TPG_{it}^{RoW} + \boldsymbol{\beta_5 X_{it}} + \varepsilon_{it} \qquad (4)$$

Where the dependent variable is the annual rate of growth of real GDP (g_{it}) and the main independent variable of interest is the weighted average growth of trading partners in sub-Saharan Africa (TPG_{it}^{SSA}), which we define as:

$$TPG_{it} = \sum_{j \neq i}^{J} W_{ijt-1} \times g_{jt} \qquad (5)$$

where W_{ijt} is the bilateral export weight we defined in (1) and g_{jt} is the trading partner's real GDP growth. As before, we use the lagged bilateral export weights to control for endogeneity. We also control for the weighted average growth of trading partners outside sub-Saharan Africa, motivated by the literature discussed in section I that has shown external growth to be important for sub-Saharan Africa countries (TPG_{it}^{RoW}).

The vector of controls ($\boldsymbol{X_{it}}$) includes various macroeconomic variables that have been shown in the literature to be associated with GDP growth, including investment to GDP, the change in the consumer price index, and trade openness (defined as the sum of exports and imports in percent of GDP), all of which are from the World Economic Outlook database. Additional controls are from various other sources including: the percent change in the bilateral exchange rates vis a vis the US dollar from the IMF's International Financial Statistics; occurrence of conflicts and war from the Uppsala Conflict Data Program database; and the percent change in the the Fed funds rate from the Federal Reserve's FRED database.

Lastly, we include average growth in sub-Saharan Africa, average global growth, and *L* lags of the dependent variable (with *L=2),* to ensure we are not confounding the effects of trading partner's growth with global or regional trends or persistence. Country fixed effects, γ_i, are included to control for time-invariant country-specific heterogeneity, and standard errors are clustered at the country level to control for possible unobserved correlation within countries.

We conduct several robustness checks to our baseline specification: excluding the top decile of economies by GDP (Angola, Ghana, Kenya, Nigeria, South Africa), estimating the model using the panel Arellano-Bond GMM estimator, adding year fixed effects to control for annual region-wide economic variations, and finally estimating the panel Arellano-Bond GMM estimator using five-year averages. This last robustness exercise allows us to minimize serial correlation, which is likely to be present in annual data. In this specification, we also include the initial level of GDP per capita to capture growth convergence, as it is standard in the growth literature.

IV. RESULTS

A. Local Projections Estimates

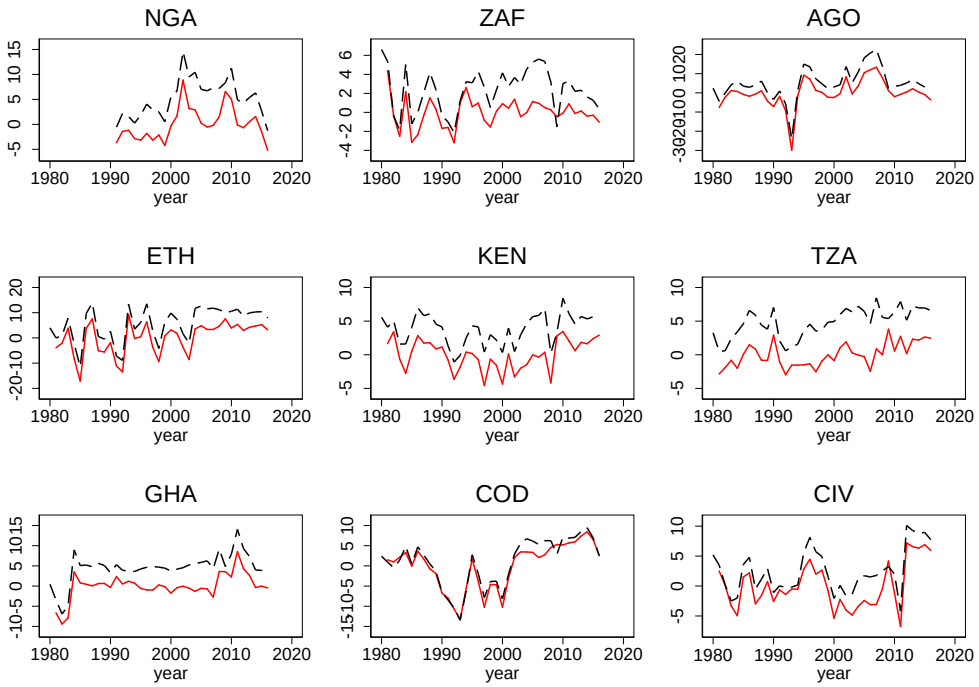
The first step in analyzing spillovers via the local projections method is to identify idiosyncratic shocks to real GDP growth in sub-Saharan African countries by estimating equation (2).[3] We take these estimated country-specific shocks (ε_{it}) and plot them along with their respective GDP growth rate in Annex II. This figure shows that the idiosyncratic shocks are highly correlated with GDP growth throughout the period in most countries. There are some exceptions, for example, from 2008-2010 – the period of the global financial crisis – the series' show some divergence in certain countries.[4] This suggests that shocks to growth

[3] In this section we show results from estimating (2) on the global sample. Annex III shows results with the shock in (2) estimated from the sub-Saharan Africa sub-sample only.

[4] The correlation is much higher in some countries (particularly the less open countries, as would be expected).

within sub-Saharan Africa, in addition to growth shocks coming from the rest of the world, are relevant factors in determining growth dynamics in sub-Saharan Africa. It further highlights the importance of identifying shocks to sub-Saharan Africa growth, which will allow us to distinguish between global shocks to growth in these countries versus shocks originating from within the region.

Figure 8. Evolution of sub-Saharan Africa real GDP growth and idiosyncratic shocks to growth – select countries



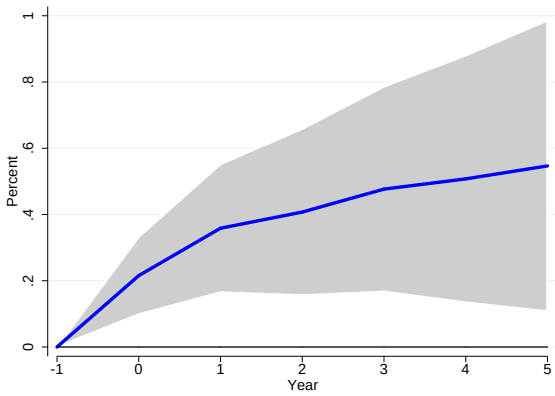
Source: IMF WEO database and author's calculations.
Note: Dashed lines are GDP growth rates, red lines are idiosyncratic shocks to GDP growth. Figures for remaining sub-Saharan Africa countries available in Annex 2.

We take these idiosyncratic shocks, weight them by bi-lateral exports (as defined in equation (1)) and estimate their impact on real output in sub-Saharan African countries using the panel-based local projections specification defined in equation (3). The estimated impulse response function is reported in Figure 9 and represents the impact of a 1 percent shock to export-weighted real GDP growth on output in the average sub-Saharan Africa country. We find that, on average, this shock increases real-GDP by about 0.2 percent on impact. The maximum impact occurs after about four years and is equal to and increase of about 0.5 percent in real GDP of the average sub-Saharan Africa country.[5] Figure 10 show the same

[5] We also estimate the model (defined in (3)) on a country-by-country basis, rather than in a panel, which allows us to examine the impact of the weighted-average shock on each country in sub-Saharan Africa. Results are consistent with the average impact and available upon request.

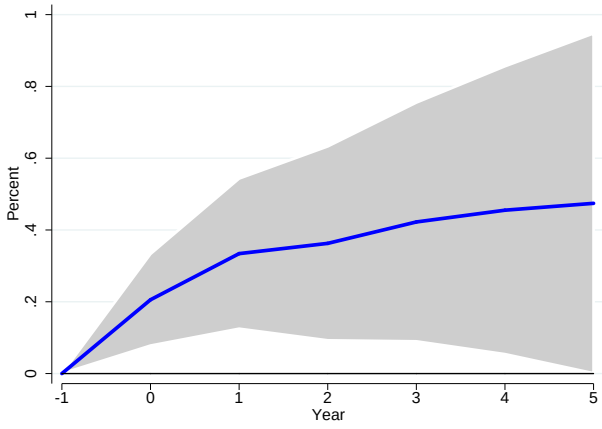
impact, excluding the largest decile of economies in sub-Saharan Africa. The results are highly robust to our baseline estimated in Figure 9, suggesting the large economies are not driving the result. Nonetheless, the largest economies in the region do have an important influence on their neighbors. Figure 11 plots the impulse response function from our specification looking at the effect of a one percent positive idiosyncratic shock in South Africa only, to average output in other sub-Saharan Africa countries. In this case, the estimated impact is larger and much more persistent.[6] That the average response to the South African shock is larger in magnitude and more persistent to our weighted average of all sub-Saharan Africa shocks is not surprising, given the important weight of South Africa in regional trade we documented in Section II, and reinforces the importance of South Africa in the continent's economic performance.

Figure 9. Effect of a one percent weighted average shock to output in sub-Saharan Africa countries (weighted by bi-lateral trade)



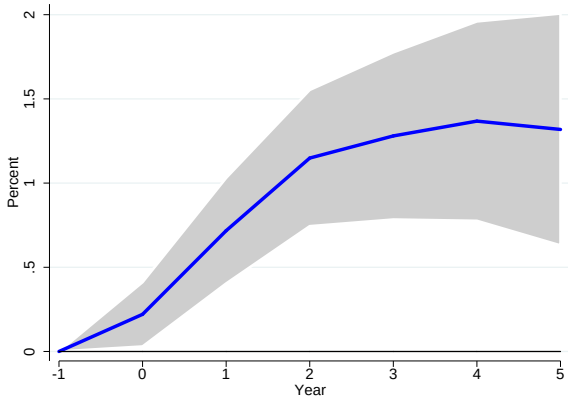
Source: Author's calculations.
Note: Shock occurs at t=0. The weighted average shock is calculated for each country pair i and j as the share of country's i's imports from j in country i's total imports from sub-Saharan Africa, as defined in equation (1).

Figure 10. Effect of a one percent weighted average shock to output in sub-Saharan Africa countries (weighted by bi-lateral trade, excluding largest economies)



Source: Author's calculations.
Note: Shock occurs at t=0. The weighted average shock is calculated for each country pair i and j as the share of country's i's imports from j in country i's total imports from sub-Saharan Africa, as defined in equation (1). Angola, Ghana, Kenya, Nigeria, and South Africa excluded from sample.

Figure 11. Effect of a one percent shock in South Africa to output in sub-Saharan Africa countries



Source: Author's calculations.
Note: Shock occurs at t=0. The shock is derived for South Africa in equation (2).

[6] Extending the horizon shows that the shock dies out after approximately two decades.

B. Panel Fixed Effects Analysis

Sub-Saharan Africa Spillovers

We then estimate the growth spillovers in sub-Saharan Africa via a panel fixed effects regression defined in equation (4), and report results in of Table 1. This table show a 1 percentage point increase in the export-weighted growth rate of intraregional partners is associated with an estimated coefficient of 0.15 on the growth of the average sub-Saharan African country (column 2) – implying an increase of about 0.2 percent in the long run.[7] This suggests there are significant growth spillovers between trading partners in the region, consistent in magnitude to those estimated from the local projections' method. We also find that a 1 percentage point increase in the growth rate of the trading partners outside of the region is associated with an increase of 0.35 percent in the growth rate of the average sub-Saharan Africa country in the long run, though not statistically significant.

Starting from column (3), we estimate our model using panel GMM to address endogeneity concerns with respect to the effect of lag GDP growth: the coefficient estimates of regional spillovers is only slightly higher at 0.21 percent, or estimated growth of 0.25 percentage points higher for the average sub-Saharan Africa country for every 1 percentage point increase in export-weighted growth of its intraregional partners. In column (4) we exclude the largest economies in sub-Saharan Africa, to ensure our results are not being driven by large countries alone, and we see little change in the coefficient estimate. In column (5), we introduce year effects to control for global economic shocks. These fixed effects, for instance, would capture the rise of China and its effect on the global economy. By including time fixed effects, we ensure that our estimated cross-country correlations are not the result of common shocks. In the last column, we estimate a panel GMM with 5-year averages, both to account for endogeneity in the dynamic-panel context and to capture medium-term determinants of growth. The 5-year average coefficient estimate is slightly lower than the baseline, suggesting regional trading partners are still important, albeit slightly less so when the annual variations are smoothed out.

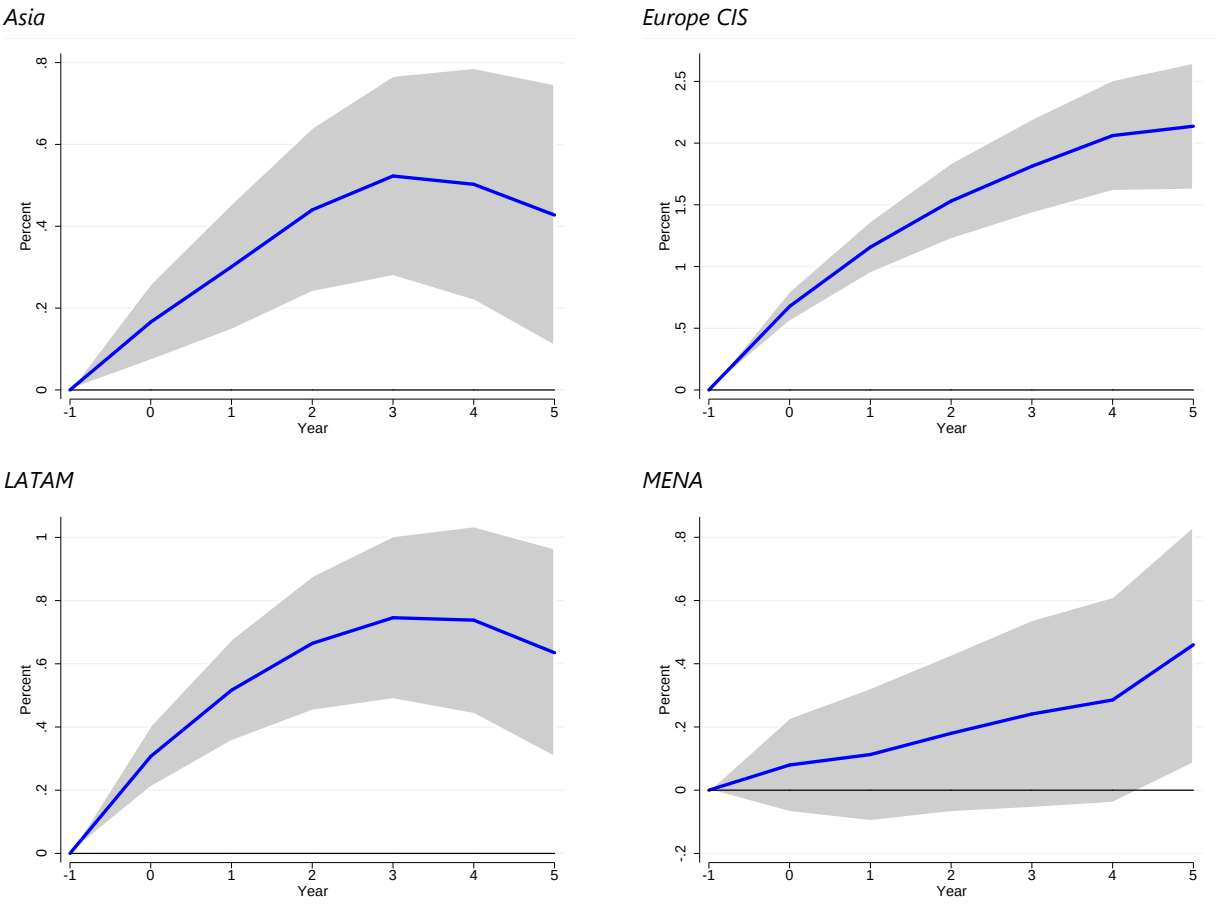
C. International Comparisons

Given the comparability between sub-Saharan Africa and other emerging and developing regions in terms of region trade, as shown in Figure 3, we now turn to examining more carefully how sub-Saharan Africa compares to other regions. In order to compare our estimated growth spillovers for sub-Saharan Africa with those in other regions, we re-estimate both analyses—the local projections method as in equation (2) and the panel fixed effects as equation (4)—for countries in Middle-East and North Africa, Latin America, Emerging and Developing Asia, and emerging and developing Europe. For the panel fixed effects model we use the GMM estimator as it is most robust to endogeneity concerns.

[7] Long run is calculated as the contemporaneous coefficient divided by one minus the lagged growth coefficients. In this case 0.15/(1-(0.283-0.0572)).

Impulse response functions for each of the four non-sub-Saharan Africa regions for the local projections' estimates are shown in Figure 12.[8] Consistent with the stylized facts presented in Figure 3, intraregional spillovers in other emerging and developing regions are of approximately the same magnitude as those in sub-Saharan Africa. In emerging and developing Asia and Latin America the estimated impact of a one percent increase in real GDP is at its largest after three years and equal to an increase in output of about 0.5-0.7 percent, only slightly larger than what we estimated for sub-Saharan Africa. The growth spillovers in emerging and developing Europe and the CIS region are substantially larger, with a 1 percent idiosyncratic shock to export-weighted GDP associated with an increase in average output of about 2 percent at its maximum. This is, however, roughly consistent with our estimated spillovers from South Africa. At the other end of the spectrum, growth

Figure 12. Growth Spillovers in Other Emerging and Developing Regions



Source: Author's calculations.

Note: Shock occurs at t=0. The weighted average shock is calculated for each country pair i and j as the share of country's i's imports from j in country i's total imports from the region indicated, as defined in equation (1).

[8] Impulse response functions are based on the estimated idiosyncratic shock using the global sample in equation (3). Results using only the region in question are generally robust, and available upon request.

spillovers in the MENA region are negligible and significantly smaller than those of sub-Saharan Africa.

Results for the panel fixed effects model are reported in Table 2 (with column 1 reproducing results from column 3 of Table 1). Again, we see that sub-Saharan Africa is either broadly in line or not significant far behind its peers in other emerging and developing regions. Relative to emerging and developing Asia, who are estimated to see an increase of about 0.28 percentage points on average following an increase in export-weighted growth of their trading partners of 1 percent, and of Eastern Europe and the Commonwealth of Independent States (CIS), who are estimated to see an increase of 0.33 percentage points following the same shock,[9] sub-Saharan African countries have slightly lower intra-regional elasticity of growth. The estimated elasticity of intra-regional growth spillovers in sub-Saharan Africa is, however, higher than that of countries in Latin America, where the long run growth spillovers are estimated to be 0.16, and the Middle-East and North Africa (MENA) where the estimated growth spillovers are not significantly different from zero (the long run impact is about -0.03, but not statistically significant). The results for Latin America and MENA countries may be explained by geography (the fact that these regions are less compact) and the high importance for trade of developments in oil markets.

V. CONCLUSION

There has long been evidence of growth spillovers across advanced countries, and between advance or emerging countries and low-income countries. Yet little evidence has been shown of growth spillovers among neighboring low-income countries, and particularly in sub-Saharan Africa. Our results fill this gap in the literature, showing that growth of countries in sub-Saharan Africa has an effect on each country's domestic growth rate, and the more so the greater is bilateral trade between countries. We find that shocks to growth in sub-Saharan African countries have spillovers to other countries in the region that are statistically significant an economically large, and robust to various different modelling specifications. A 1 percent shock in the weighted average trading partners' growth is associated with an increase of about 0.2-0.5 percent on in output of other sub-Saharan African countries. We also find that South Africa, the largest economy in the region and with the largest share of regional trade, is likely the driving force behind much of these spillovers.

Motivating our econometric analysis is the increasing trend towards regional integration in sub-Saharan Africa that we have documented, a novel result that is contrary to the common perception of countries in the continent as silos who are integrated with the rest of the world but not with each other. Indeed, trade integration in sub-Saharan Africa is now at comparable levels with developing and emerging market economies in other regions. In particular, it is more integrated in terms of growth spillovers than the MENA region while it is roughly in line with Latin America, emerging and developing Europe and CIS, and Asia. In this vein,

[9] We exclude advanced economies from the sample, meaning that we exclude Australia, New Zealand, Hong Kong, Japan, Korea, Singapore and Taiwan from Asia, we exclude Israel from MENA, and we exclude the Czech Republic, Estonia, Lithuania, Latvia, Slovakia, Slovenia from Eastern Europe and the CIS.

we have identified the countries that are potentially the main sources and destinations for growth spillovers via trade linkages, based on their intraregional trade networks. The rate at which these countries will continue to growth will therefore have implications for their major trading partners, as our econometric analysis implies.

Supported by appropriate policies, the steady increase in trade integration experienced in sub-Saharan Africa has the potential to be further deepened. As integration continues in the region, it is likely to have positive effects on growth. But our results nonetheless stress that spillovers can go both ways, and the growing importance for policymakers to factor in spillovers from within the region and to design policies that address increasing transmission risks.

In particular, structural transformation strategies are needed to promote diversification and guard against spillovers from overreliance on too few products and partners. Deeper trade networks, as promoted by the African Continental Free Trade Agreement, are a welcome development, because they can help countries trade more products with more diverse partners. Governments should build precautionary cushions and monitor and regulate cross-border links to set the stage for growth and stability. Also, there is room to reduce tariff and non-tariff barriers, improving the ease of doing business, and favoring infrastructure development to facilitate trade between countries and between sub-regions.

Table 1. GDP Growth Elasticities of Growth of Trading Partners

Dependent variable: real GDP growth

VARIABLES	(1) Baseline	(2) Baseline	(3) GMM	(4) GMM Excluding largest	(5) GMM Year F.E.	(6) GMM 5-year averages
SSA trading partners' growth	0.132*	0.155*	0.207**	0.187**	0.144*	0.0773**
	(0.0743)	(0.0788)	(0.0812)	(0.0865)	(0.0864)	(0.0344)
Non-SSA trading partners' growth	0.151	0.271	0.401*	0.370	0.296	0.00433
	(0.165)	(0.182)	(0.214)	(0.298)	(0.230)	(0.0440)
Real GDP growth (t-1)	0.329***	0.283***	0.262***	0.252***	0.248***	0.400***
	(0.0726)	(0.0798)	(0.0276)	(0.0760)	(0.0277)	(0.0553)
Real GDP growth (t-2)	0.00291	-0.0572**	-0.0807***	-0.0776*	-0.0885***	
	(0.0249)	(0.0280)	(0.0270)	(0.0448)	(0.0272)	
Conflict		-3.815***	-3.876***	-3.089**	-3.652***	-3.876
		(1.070)	(1.230)	(1.332)	(1.225)	(2.774)
Trade openness (t-1)		0.0533*	0.0854***	0.0912	0.111***	0.0923*
		(0.0299)	(0.0158)	(0.0621)	(0.0172)	(0.0559)
Share of regional exports in total (t-1)		3.459*	1.565	2.256	4.866**	-0.149
		(1.946)	(1.821)	(2.767)	(1.951)	(2.053)
Investment, percent of GDP (t-1)		0.0479	0.0610***	0.0584	0.0630***	0.0874**
		(0.0384)	(0.0194)	(0.0561)	(0.0193)	(0.0397)
Population growth		0.411	0.516	0.498	0.592*	
		(0.436)	(0.326)	(0.368)	(0.324)	
US Federal Funds rates, % change		-9.88e-06	-0.000128	-0.000206	0.00163	
		(0.000613)	(0.000938)	(0.000593)	(0.00156)	
Inflation		-0.00367***	-0.00319	-0.00196	-0.00455**	
		(0.00113)	(0.00209)	(0.00299)	(0.00210)	
Inflation (t-1)		-0.00102	-0.000249	-0.00262	-0.00104	
		(0.000726)	(0.00211)	(0.00241)	(0.00214)	
Foreign exchange rate, % change		0.183***	0.159	0.100	0.230**	
		(0.0560)	(0.103)	(0.141)	(0.104)	
Foreign exchange rate, % change (t-1)		0.0599	0.0186	0.133	0.0536	
		(0.0361)	(0.106)	(0.120)	(0.108)	
SSA average growth	0.287**	0.0758	0.0345	-0.00671		
	(0.120)	(0.217)	(0.121)	(0.266)		
World average growth	0.105	0.200	0.0392	0.0467		
	(0.149)	(0.232)	(0.250)	(0.284)		
Constant	0.562	-5.013*	-7.186***	-7.475	-7.154***	-9.591*
	(0.612)	(2.609)	(1.482)	(5.849)	(2.080)	(5.742)
Observations	1,460	1,301	1,252	1,118	1,252	159
Period FE	NO	NO	NO	NO	YES	YES
Number of countries	45	45	45	40	45	43

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: IMF, staff calculations.

Table 2. Sub-Saharan Africa and Other Developing Countries: GDP Growth Elasticities of Growth of Trading Partners

Dependent variable: real GDP growth

	(1) SSA	(2) Latin America	(3) MENA	(4) Asia	(5) Europe and CIS
Regional trading partners' growth	0.207**	0.126*	-0.0335	0.256**	0.233
	(0.0841)	(0.0743)	(0.0768)	(0.129)	(0.184)
Non-regional trading partners' growth	0.401	-0.0770	-0.109	0.435***	0.477***
	(0.305)	(0.177)	(0.221)	(0.165)	(0.140)
Real GDP growth (t-1)	0.262***	0.208***	0.000407	0.162**	0.322***
	(0.0688)	(0.0408)	(0.0352)	(0.0797)	(0.0977)
Real GDP growth (t-2)	-0.0807*	-0.00484	-0.195**	-0.0749**	-0.0373
	(0.0438)	(0.0370)	(0.0805)	(0.0332)	(0.0868)
Average regional real growth	0.0345	0.271**	0.509**	0.235	0.373*
	(0.284)	(0.106)	(0.225)	(0.152)	(0.197)
World real GDP growth	0.0392	0.479***	0.184	-0.0651	-0.159
	(0.270)	(0.166)	(0.371)	(0.216)	(0.208)
Conflict	-3.876***	-2.509	-4.781	-0.884*	-0.675
	(1.246)	(1.686)	(3.483)	(0.518)	(1.220)
Trade openness (t-1)	0.0854	0.0183***	0.0346*	0.00773	0.0270*
	(0.0582)	(0.00704)	(0.0204)	(0.0101)	(0.0146)
Share of regional exports in total exports (t-1)	1.565	-2.162	2.619	-1.018	2.981
	(2.842)	(1.368)	(2.736)	(1.729)	(3.287)
Investment share of GDP (t-1)	0.0610	-0.173***	0.235**	0.0328	-0.00303
	(0.0566)	(0.0350)	(0.109)	(0.0260)	(0.0857)
Percent growth	0.516	0.340	-0.531	0.190***	0.335
	(0.356)	(0.337)	(0.370)	(0.0168)	(0.485)
US Federal Funds rates, percent change	-0.000128	0.000928	0.00103	0.000202	-0.00130*
	(0.000561)	(0.000731)	(0.000969)	(0.000507)	(0.000707)
Inflation	-0.00319***	-0.00312	-0.0646***	-0.00861	-0.00309
	(0.000999)	(0.00205)	(0.0228)	(0.0132)	(0.00191)
Inflation (t-1)	-0.000249	-2.12e-05	0.0809**	-0.00421	-0.000360
	(0.00156)	(0.000352)	(0.0383)	(0.0135)	(0.00129)
Foreign exchange rate, percent change	0.159***	0.300	-0.824	-1.763*	-0.175
	(0.0474)	(0.226)	(0.508)	(1.015)	(0.113)
Foreign exchange rate, percent change (t-1)	0.0186	-0.0114	0.723	0.546	0.0149
	(0.0797)	(0.00912)	(0.756)	(0.451)	(0.110)
Constant	-7.186	2.873***	-3.520*	-0.884	-2.769
	(5.473)	(1.031)	(1.951)	(1.771)	(2.922)
Observations	1,252	941	560	517	453
Number of countries	45	30	20	20	21

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: IMF staff calculations.

References

Almansour, A., A. Aslam, J. Bluedorn, and R. Duttagupta. 2015 "How Vulnerable Are Emerging Markets to External Shocks?" Journal of Policy Modeling 37, no 3: 460-483.

Arizala, F., M. Bellon, M. MacDonald, M. Mlachila, and M. Yenice. 2018. “Regional Spillovers in Sub-Saharan Africa—Exploring Different Channels.” IMF Spillover Note 12. International Monetary Fund, Washington, DC.

Arora, V., and A. Vamvakidis. 2005. “How Much Do Trading Partners Matter for Economic Growth?” IMF Staff Papers 52(1): 24–40.

Arora, V. and Vamvakidis, A., 2005b. “The Implications of South African Economic Growth for the Rest of Africa”. South African Journal of Economics, 73(2), pp.229-242.

Balami, D., I. Ogboru, and D. Talba. 2011. “The Cereal Economy in Nigeria and the Sub-Regional Dimension,” Social Study Science Group, Vol. 1, No. 29.

Baldwin, R. E., 2003, "Openness and Growth: What's the Empirical Relationship?" NBER Working Paper No. 9578 (Cambridge, Massachusetts: National Bureau of Economic Research).

Barrot, L.D., C. Calderón, and L. Servén, 2018, “Openness, specialization, and the external vulnerability of developing countries”, Journal of Development Economics, 134, pp.201-328.

Basdevant, O. 2012. “Fiscal Policies and Rules in the Face of Revenue Volatility Within Southern Africa Customs Union Countries (SACU).” IMF Working Paper 12/93. International Monetary Fund. Washington, DC.

Basdevant, O., Jonelis, A., Mircheva, B. and Slavov, S., 2015. The Mystery of Missing Real Spillovers in Southern Africa: Some Facts and Possible Explanations. South African Journal of Economics, 83(3), pp.371-389.

Blonigen, B., Piger J., and Sly N. "Comovement in GDP trends and cycles among trading partners." Journal of International Economics 94.2 (2014): 239-247.

Bonfatti, R. and Poelhekke, S., 2017. “From Mine To Coast: Transport Infrastructure And The Direction Of Trade In Developing Countries”. Journal of Development Economics, 127, pp.91-108.

Chen, W., and R. Nord. 2017. “A Rebalancing Act for China and Africa: The Effect of China’s Rebalancing on sub-Saharan Africa’s Trade and Growth,” African Department Paper. International Monetary Fund, Washington, DC.

Collier, P. and S. A. O’Connell, 2007, “Growth and Opportunities”, in Benno J. Ndulu, Robert H. Bates, Paul Collier and Charles C. Soludo (eds.), The Political Economy of Economic Growth in Africa, 1960–2000, Cambridge: Cambridge University Press.

Dabla-Norris, Era, Raphael Espinoza, and Sarwat Jahan. "Spillovers to Low-Income Countries: Importance of Systemic Emerging Markets." *Applied Economics* 47, no. 53 (2015): 5707-5725.

di Giovanni, J., Levchenko, A.A. and Mejean, I., 2018. The Micro Origins Of International Business-Cycle Comovement. *American Economic Review*, *108*(1), pp.82-108.

Doyle, Brian M., and Jon Faust. "Breaks in the variability and comovement of G-7 economic growth." Review of Economics and Statistics 87, no. 4 (2005): 721-740.

Drummond, P., and G. Ramirez, 2009. "Spillovers From the Rest of the World into Sub Saharan African Countries" IMF Working Paper 09/155 (Washington).

Dufrenot, G., Mignon, V. and Tsangarides, C., 2010. The trade-growth nexus in the developing countries: A quantile regression approach. Review of World Economics, 146(4), pp.731-761.

Easterly, William and Ross Levine, 1998, Troubles with the Neighbors: Africa's Problem, Africa's Opportunity, Journal of African Economies, 7(1): 120-142.

Furceri, D., J.T. Jalles, and A. Zdzienicka. 2016. "China Spillovers: New Evidence from Time-Varying Estimates". IMF Spillover Note. International Monetary Fund, Washington, DC.

Jorda, O. 2005. "Estimation and Inference of Impulse Responses by Local Projections" American Economic Review 95(1), 161-182

International Monetary Fund. 2012." Maintaining Growth in an Uncertain World", Sub-Saharan Africa Regional Economic Outlook, October. Washington, DC.

_____. 2014. "South Africa—Financial Stability Assessment." IMF Country Report No. 14/340, Washington, DC.

_____. 2015a. "Pan-African Banks: Opportunities and Challenges for Cross-Border Oversight". Washington, DC.

_____. 2016a." Time for a Policy Reset", Chapter 1, Sub-Saharan Africa Regional Economic Outlook, April. Washington, DC.

_____. 2016b." Time for a Policy Reset", Chapter 3, Sub-Saharan Africa Regional Economic Outlook, April. Washington, DC.

_____. 2016c. "Macro-Financial Risks from Linkages between Banks and Non-Bank Financial Institutions." IMF Country Report 16/374. Washington, DC.

_____. 2017a2017a.” The Quest for Recovery”, Chapter 1, Sub-Saharan Africa Regional Economic Outlook, October. Washington, DC.

_____. 2017b Restoring Sub-Saharan Africa’s Growth Engine”.. Chapter 1, Regional Economic Outlook Sub-Saharan Africa, April. Washington, DC.

_____. 2017c2017c. “Fintech and Financial Services: Initial Considerations” IMF Staff Discussion Notes. Washington, DC.

Kriljenko, M.J.I.C., Gwenhamo, M.F. and Thomas, M.S., 2013. “Inward and outward spillovers in the SACU Area” IMF Working Paper No. 13/31).

Mirestean, A. and Tsangarides, C.G., 2009. Growth determinants revisited. IMF Working Paper 09/268.

Moore, A.J., 2018. Growth spillovers and market access in Africa. Oxford Economic Papers, 70(2), pp.375-391.

Mullings, R. and Mahabir, A., 2018. Growth by Destination: The Role of Trade in Africa’s Recent Growth Episode. World Development, 102, pp.243-261.

Raddatz, C., 2008a. Have external shocks become more important for output fluctuations in African countries? In: Go, Delfin S., Page, John (Eds.), Africa at a Turning Point? Growth, Aid, and External Shocks. The World Bank, Washington, DC, pp. 343–374.

Roberts, M. and Deichmann, U., 2011. International growth spillovers, geography and infrastructure. The World Economy, 34(9), pp.1507-1533.

Overseas Development Institute. 2010. “Impediments to Intra-Regional Trade in sub-Saharan Africa”. London. September 2010.

Schlicht E (1985) Isolation and aggregation in economics. Springer-Verlag, Berlin, Heidelberg, New York,Tokyo. 22

Schlicht E (1988) Variance estimation in a random coefficients model. Paper presented at the Econometric Society European Meeting Munich 1989

Shahbaz, M., 2012. Does trade openness affect long run growth? Cointegration, causality and forecast error variance decomposition tests for Pakistan. Economic Modelling, 29(6), pp.2325-2339.

Sly, N. and Weber, C. (2013) International Fiscal Policy Coordination and GDP comovement. CESifo Working Paper, No. 4358, Center for Economic Studies and Ifo Institute (CESifo), Munich

Yang, Y. and Samaké, I., 2011. Low-Income Countries' BRIC Linkage: Are There Growth Spillovers? IMF Working Paper 11/267

Annex I. Gravity Equation Estimation for 1980-2016 Trade Flows

We estimate a gravity model of bilateral trade flows over the period 1980-2016 to study the determinants of regional trade integration. In all specifications, the sample includes annual data from the DOTS database with all the country pairs in the world that exchanged goods at least once.

The first specification is as follows:

$$\log F_{ijt} = \alpha_i + \phi_j + \theta_t + \beta X_{ij} + \beta_{xr} xr_{ijt} + \gamma Y_{it} + \delta Z_{jt} + \varepsilon_{ijt} \qquad \text{(A1)}$$

where F_{ijt} is the logarithm of export values in dollars from country *i* to country *j*, X_{ij} corresponds to corridor-specific variables including geographic distance, dummy variables indicating whether the countries share a common official language, share the same ethnic group, share the same colonial origin, share a common official religion, or share a currency, xr_{ijt} corresponds to bilateral exchange rates, and Y_{it} and Z_{it} respectively refer to the logarithms of GDP per capita and population in the origin and destination countries. The specification includes country fixed-effects, α_i and ϕ_j, to control for country time-invariant characteristics, as well as time effects, θ_t, to control for all annual shocks common to all countries.

The specification in Table A.1 column 2 includes country-time fixed-effects, γ_{it} and δ_{it}, to control for all country variable characteristics. The corridor variables X_{ij} in (A1) are kept but the country-level characteristics (population and GDP) are dropped as these characteristics are absorbed by the country-time fixed-effects. Hence the results presented in column 2 refer to the specification:

$$\log F_{ijt} = \beta X_{ij} + \gamma_{it} + \delta_{it} + \varepsilon_{ijt} \qquad \text{(A2)}$$

Estimation results in the first two columns of Table 1.1 show that distance significantly hampers trade flows across countries. The first column additionally shows that exports increase significantly with both population and GDP per capita of both the origin and destination countries, and are also higher between partners sharing a common language, ethnicity and colonial heritage. Bilateral exchange rates do not have a significant effect on bilateral trade flows.

In Table A.1 column 3, all countries in the world (including those not in sub-Saharan Africa) are included. The specification is also richer as interaction variables between measures of distance and a dummy variable for both sub-Saharan Africa origin and destination countries ($I_{i,j\in SSA}.X_{ij}$) are introduced:

$$\log F_{ijt} = \beta X_{ij} + \theta I_{i,j\in SSA}.X_{ij} + \gamma_{it} + \delta_{it} + \varepsilon_{ijt} \qquad \text{(A3)}$$

This specification allows us to investigate whether distance plays a specific role for export flows within sub-Saharan Africa. Coefficient estimates θ of these interaction variables respectively reflect the differential effects of distance for sub-Saharan Africa origin and

destination countries. The results indicate that contiguity is a greater advantage when exporting to sub-Saharan destinations, as it is the benefit of having the same currency.

In Table A.1 column 4, we explore whether trade integration occurred faster between countries that belonged to the same economic union the WAEMU, CEMAC, EAC, SADC and SACU (definitions are based on memberships as of 2016). We estimate the following specification:

$$\log F_{ijt} = \alpha_{ij} + \gamma_{it} + \delta_{it} + \beta(X_{ij}.t) + \phi_1 I_{waemu}.t + \phi_2 I_{cemac}.t + \phi_3 I_{eac} + I_{sadc}.t + \phi_4 I_{sacu}.t + \varepsilon_{ijt} \quad \text{(A4)}$$

where country-time, δ_{it} and γ_{it}, and country-pair, α_{ij}, fixed effects are included, where corridor fixed characteristics are interacted with a time trend, $(X_{ij}.t)$, and memberships to a common sub-region are respectively interacted with a time trend.

As shown in column 4, we find a statistically significant evidence that integration between members of the EAC and the SADC was particularly successful in fostering trade. This relationship holds even after controlling for developments in individual countries when we introduce country-time effects. Quantitatively, trade between members of the EAC increased by an additional 4 percent per year on average while trade between members of the SADC increased by an additional 2 percent per year. Using these estimates to compute what trade would have been without sub-regional integration, we find that average annual growth in regional trade would have been around 9 percent instead of 11 percent, thereby translating into trade levels that would be half as low as the observed in 2015. In addition, the coefficient on the interaction between distance and time suggests that in sub-Saharan Africa, distance has increasingly become a barrier over time, meaning that the infrastructure facilitating trade between economic unions has lagged relative to the development of infrastructure within unions.

Table A.1. Gravity equations: Determinants of trade flows

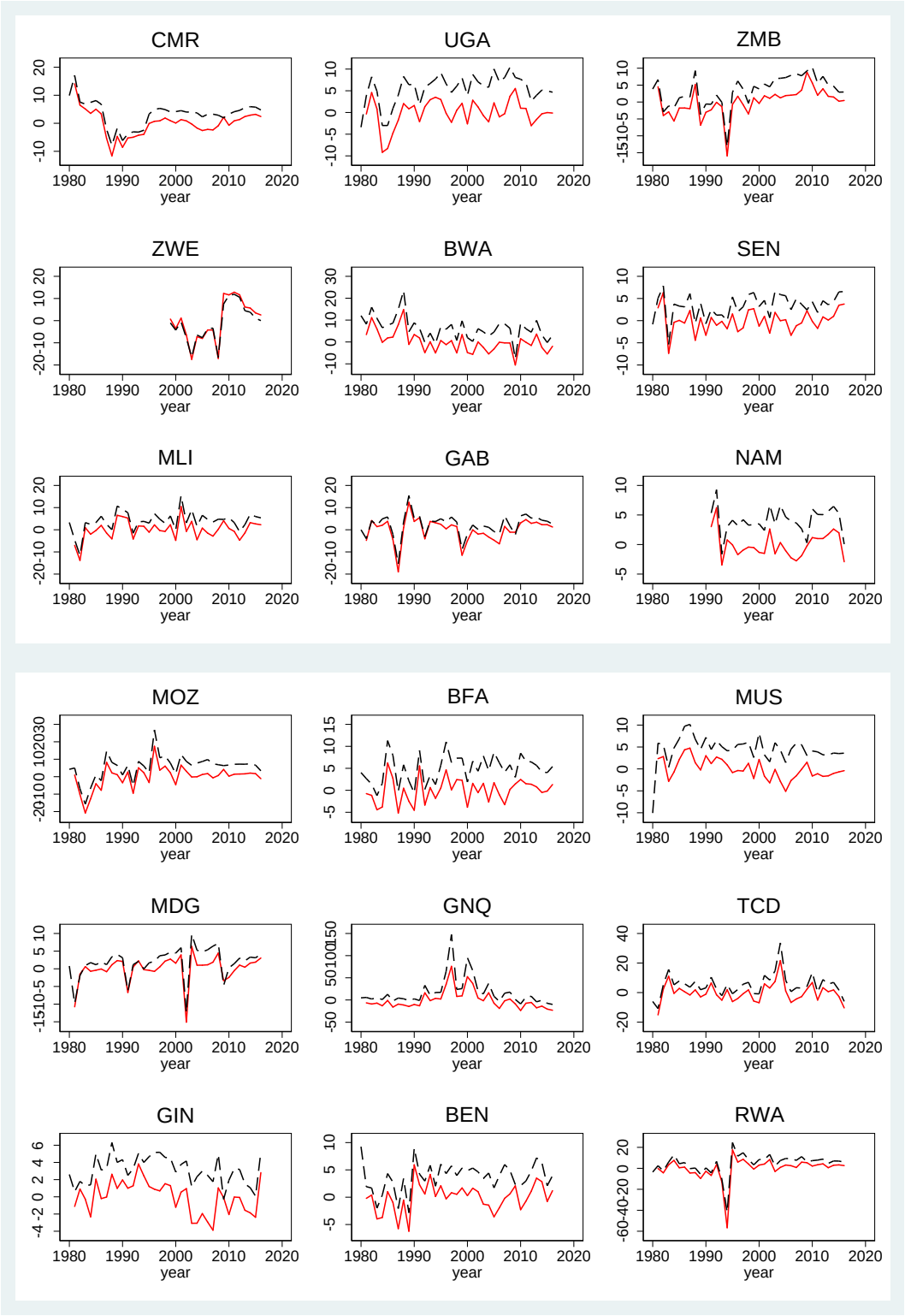
Dependent variable: logarithm of bilateral trade flows

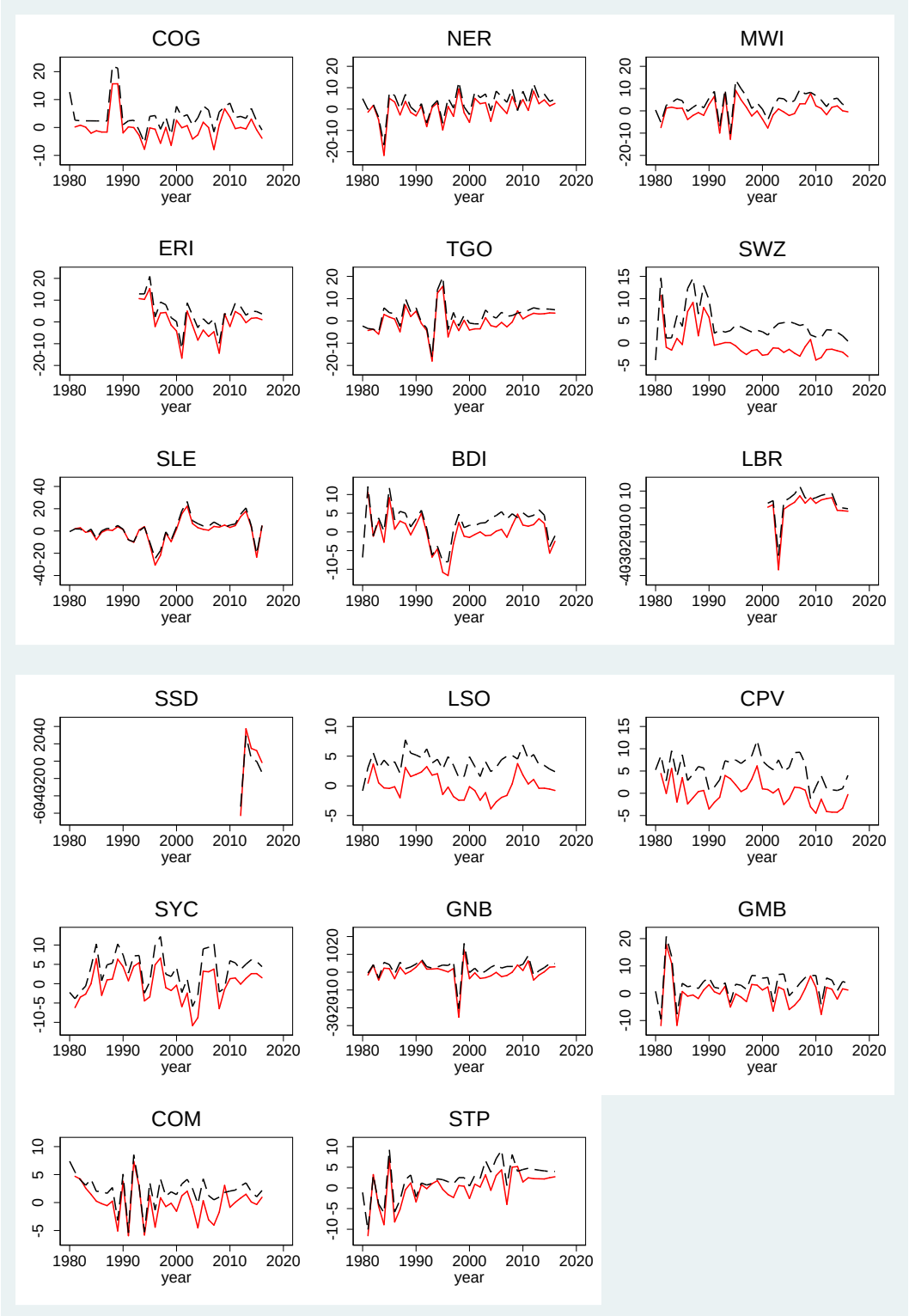
	(1) Country controls (SSA only)	(2) Country FE (SSA only)	(3) World-wide (SSA interactions)		(4) Time trends
				Interaction variables:	
Contiguous countries	1.57***	1.53***	0.29**	Contiguous countries * t	-0.00
	(0.21)	(0.21)	(0.12)		(0.01)
Distance (in log)	-1.60***	-1.60***	-1.63***	Distance * t	-0.02***
	(0.09)	(0.09)	(0.04)		(0.00)
Common language	0.46***	0.45***	0.54***	Common language * t	0.01
	(0.15)	(0.14)	(0.08)		(0.01)
Common ethno	0.24*	0.30**	0.20***	Common ethno * t	0.01
	(0.14)	(0.13)	(0.07)		(0.01)
Belonged to common colony	1.44***	1.37***	1.08***	Common colony * t	-0.00
	(0.13)	(0.12)	(0.10)		(0.01)
Common religion	0.14	0.14	0.24***	Common religion * t	0.00
	(0.14)	(0.13)	(0.06)		(0.01)
Common currency	1.22***	1.28***	0.37		
	(0.31)	(0.31)	(0.29)		
Origin GDP p.c.	0.49***				
	(0.06)				
Destination GDP p.c.	0.48***				
	(0.13)				
Origin population	0.70**				
	(0.30)				
Destination population	2.41***				
	(0.24)				
Origin/destination FX rate	0.00				
	(0.01)				
Interaction variables:					
Contiguous countries * SSA indicator			0.95***	WAEMU indicator * t	0.00
			(0.23)		(0.01)
Distance * SSA indicator			-0.01	CEMAC indicator * t	0.00
			(0.02)		(0.01)
Common language * SSA indicator			0.16	EAC indicator * t	0.04*
			(0.20)		(0.02)
Common ethno * SSA indicator			0.16	SADC indicator * t	0.02**
			(0.21)		(0.01)
Common colony * SSA indicator			0.10	SACU indicator * t	0.09
			(0.29)		(0.07)
Common religion * SSA indicator			-0.08		
			(0.32)		
Common currency * SSA indicator			0.77**		
			(0.39)		
Observations	92,132	95,711	556,476		95,108
R-squared	0.52	0.57	0.73		0.77
Year FE	YES	NO	NO		NO
Country FE	YES	NO	NO		NO
Country-time FE	NO	YES	YES		YES
Country-pair FE	NO	NO	NO		YES

Clustered standard errors in parentheses (Destination country) *** p<0.01, ** p<0.05, * p<0.1

Source: IMF DOTS and WEO databases and authors' calculations.

Annex II. Evolution of sub-Saharan Africa real GDP growth and idiosyncratic shocks to growth

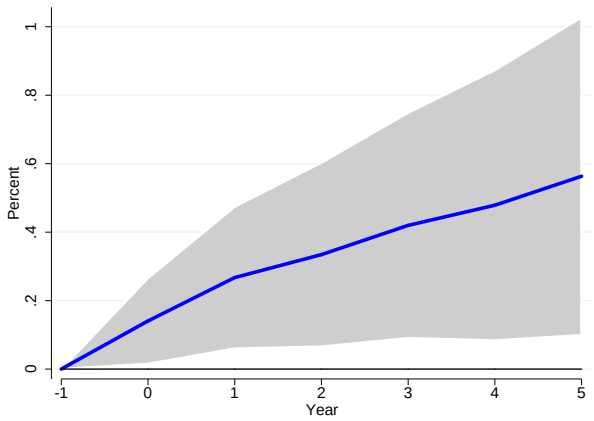




Source: IMF WEO database and author's calculations.
Note: Dashed lines are GDP growth rates, red lines are idiosyncratic shocks to GDP growth. Figures for remaining sub-Saharan Africa countries available in Appendix 2.

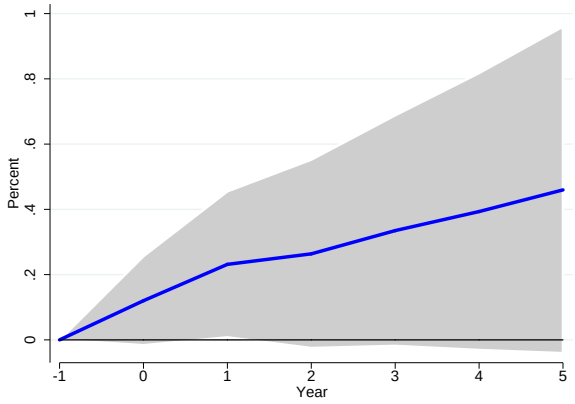
Annex III. Impulse Response Functions with Idiosyncratic Shock Estimated on sub-Saharan Africa subsample

Figure AIII.1 Effect of a one percent weighted average shock to output in sub-Saharan Africa countries (weighted by bi-lateral trade)



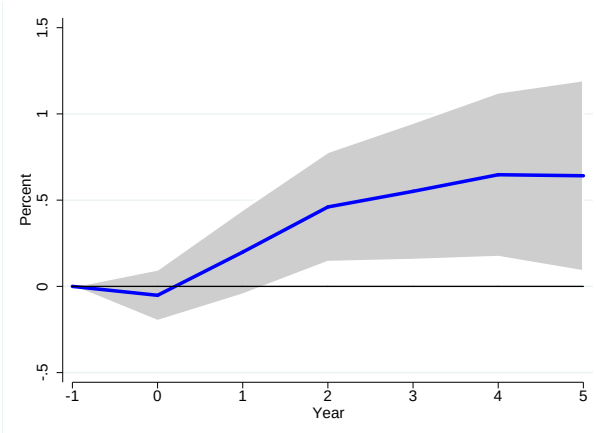
Source: Author's calculations.
Note: Shock occurs at t=0. The weighted average shock is calculated for each country pair i and j as the share of country's i's imports from j in country i's total imports from sub-Saharan Africa, as defined in equation (1).

Figure AIII.2. Effect of a one percent weighted average shock to output in sub-Saharan Africa countries (weighted by bi-lateral trade, excluding largest economies)



Source: Author's calculations.
Note: Shock occurs at t=0. The weighted average shock is calculated for each country pair i and j as the share of country's i's imports from j in country i's total imports from sub-Saharan Africa, as defined in equation (1). Angola, Ghana, Kenya, Nigeria, and South Africa excluded from sample.

Figure AIII.3. Effect of a one percent shock in South Africa to output in sub-Saharan Africa countries



Source: Author's calculations.
Note: Shock occurs at t=0. The shock is derived for South Africa in equation (2).