A fiscal stimulus to address the effects of the global financial crisis on sub-Saharan Africa

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Key messages:

- The global financial crisis will have a major impact on development. We estimate that the output loss for sub-Saharan Africa (SSA) alone is around US$ 40 – 50 billion in 2008- 2009

- Developed countries have announced fiscal packages worth close to US$2 trillion to address the effects of the global financial crisis – the effects of these packages help to smooth income losses in SSA in 2009-2010, offsetting about a quarter of losses due to the financial crisis.

- Developed countries can support a fiscal stimulus in developing countries through increased aid (e.g. in the form of budget support or funds for Aid for Trade and infrastructure). The empirical literature suggests that productive investment in infrastructure increases growth in developing countries and SSA specifically and the results in this paper confirm that further infrastructure spending increases growth for a sustained period.

- We use a quarterly macro econometric model (NIESR's NIGEM) to simulate a US$ 20 and a US$ 50 billion fiscal expansion in SSA. Both are illustrative and chosen because respectively US $50 billion is approximately the output loss to SSA caused by the series of exogenous shocks initiated by the GFC; and $20 billion is approximately 1% of the $2trillion sum of all national stimulus packages in developed and emerging economies. Taken together, the developed countries' domestic fiscal stimuli and a US$20 billion sub-Saharan Africa stimulus spent on current consumption offset about half of the impact of the global financial crisis on GDP growth in sub-Saharan Africa in 2009 and 2010 raising growth in SSA by some 2 percentage points in 2009-2010. This still leaves a significant gap in GDP, which could be filled by increasing the size of the stimulus package to around US$50 billion, offsetting more than 85 per cent of the impact.

- If US$ 50 billion goes to debt relief in SSA, the initial growth effects are small but growth effects are larger later in the cycle. If the stimulus is spent on consumption (income transfers, social safety nets etc) it can smooth income losses and increase incomes by 4% in 2009 and a further 1% in 2010. If the stimulus goes to productive investment there is a similar income smoothing effect over the short term, but in addition there is a long-run positive impact on the level of output, which remains about 1.5% higher, while other stimuli do not shift the long-run level of potential output. Further, the stimulus on infrastructure could have a further sustained increase in output by an additional 1%.

- A stimulus in SSA of US$ 50 billion has positive effects on global trade, and world GDP would be 0.1% higher in 2009-2010 as a result (this is equivalent to US$44 billion world wide, and of this around 15% or USD 6 billion benefits the rest of the world outside SSA). US and Chinese exports would increase by about US$1.4 billion in 2009; German exports would increase by about US$1.9 billion and UK exports by US$ 0.7 billion

- Assuming that it is possible to find US$ 50 billion of productive investment in SSA infrastructure, and based on the rates of return we have seen in the past for infrastructure projects, and that funds are provided in the form of well managed aid with capable local institutions implementing the investment, the simulations on the model suggest world output would increase by US$ 250 billion, with much of it in sub-Saharan Africa, and around $20 billion in the rest of the world. The cumulative impact after 10 years of a fiscal stimulus in consumption is around US$ 60 billion in world GDP.

- The infrastructure investment scenario would "pay for itself" by 2016. After 5 years, in the infrastructure investment scenario, Euro Area export volumes have increased by a cumulative $12.9 billion; of which $3 billion is in Germany. UK export volumes have increased by a cumulative $1.5 billion and US export volumes by $3.6 billion.

1

1 Introduction

The global financial crisis will have a major impact on developed and developing countries alike. The developed and richer developing countries have begun to address the consequences of the crisis and have announced various fiscal stimuli. The G-20 countries have announced fiscal stimuli worth around 1.5% of GDP, or some US$ 2 trillion, to cushion the consequences of the global financial crisis. It will matter greatly for poor countries (non-G20) countries, such as African countries, whether part of such a stimulus is provided in poor countries or whether the entire stimulus is kept in the G20. This paper examines the effects of various fiscal stimuli on growth in the world, in developed countries, and sub-Saharan Africa (SSA) and uses a calibrated macroeconomic model of the world economy.

Several recent studies discuss a fiscal stimulus for developing countries. The World Bank President, Robert Zoellick, has argued that 0.7% of the developed country stimulus, worth around US$ 15 billion, should be used to finance a vulnerability fund for developing counties to spend on infrastructure, safety net and SME projects. The campaigning organization One suggests that 1% or some US$ 20 billion should be provided to Africa. IMF (2009) provides current baseline projections for 2009 which suggest an aggregate additional financing need for LICs of about US$ 25 billion. However much larger financing needs, up to US$ 140 billion, would result if various downside risks were to materialise. The World Bank (2009) suggests that developing countries face a financing gap of US$270-US$700 billion depending on the severity of the crisis and the strength and timing of the policy responses. Birdsall (2009) discusses the financial resources for a cash injection into the world economy and suggests that one trillion US$ could be resourced, though this is not based on needs. Te Velde (2009) uses the revisions in growth forecasts by the IMF (July 2008 to present) and suggests that the global financial crisis has already led to an estimated output loss (assuming that the revisions can be attributed only to the crisis) of US$ 2.7 trillion in the world (around 5% of world GDP), US$ 737 billion in developing countries and US$ 51 billion in SSA.

This paper examines the effects of providing an aid financed fiscal stimulus in sub-Saharan Africa. Section 2 provides a brief review of the literature on aid, public expenditure and growth in Africa. Section 3 discusses the policy scenarios. Section 4 explains the results of the model simulations. Section 5 concludes.

2 Aid, public expenditure and growth in sub-Saharan Africa

There is a large literature on aid, public expenditure and growth, and poverty in sub-Saharan Africa. This section first describes the macro economic literature on fiscal expansion and growth in SSA (Section 2.1) and then reviews the different effects in different sectors such as investment in infrastructure (Section 2.2), agriculture (Section 2.3), energy efficiency (Section 2.4) and then concludes.

2.1 Aid, fiscal expansion and growth

The macroeconomic literature on aid, fiscal expansion and growth deals with two issues (apart from fungibility of aid concerns). The first is whether aid is actually absorbed and spent, and the second is how aid is spent: on non-tradeables or long-run productive capacity. Killick and Foster (2006) examine the effects of aid on growth. Recent aid surges improved GDP growth in four countries, and good growth performance (albeit slightly slower) was maintained in Mozambique and Uganda. Slow growth in Ethiopia was due to drought. Inflation remained under control in three countries, and showed progress towards stabilisation in a further three countries. Only Mozambique experiences some inflation potential. The aid surge was accompanied by higher investment in six countries and little change in Ghana, but (private investment) fell in Tanzania and Ethiopia. Increased aid responded to the ending of wars in Sierra Leone and Ethiopia, introduction of improved economic performance and policies in Mauritania and Tanzania, and continued good performance in Uganda and Mozambique, while it fluctuated with variable economic policy performance in Ghana.

Different impacts and challenges for macroeconomic management depend on whether the aid is absorbed (increase in the current account deficit in the absence of aid) and/or spent (increase in fiscal deficit in the absence of aid). There is a fear that the absorption process may require an exchange rate rise, which may induce a "Dutch disease" problem that exchange rate appreciations (due to inflationary pressures coming from the non-tradeable sector) will hamper the export sector. Spending can also have the same effect by raising the relative prices of non-tradeables (shifting production preferences for non-tradeables and affecting the prospects of positive long term growth).

The authors survey an IMF study that identifies full absorption and spending as the best aid management option. When aid finances additional imports, and the increase in domestic demand is therefore matched with increase in net imports, there is no change to the domestic supply-demand balance. But, the authors add, that such a scenario depends on different factors: quality of spending; elected channels for spending; initial state of the public finances; overall macroeconomic situation; expectations on sustainability of aid flow. There is no evidence of a "Dutch disease" in most countries, but it is hypothesised that it may be due to the fact that exports in those countries is driven mostly by infrastructure and market structure determinants, rather than by prices.

Adam and Bevan (2006) provide model experiments to examine the magnitude and distributional consequences of the effect of aid and public expenditure. Can the medium period gains offset the "Dutch disease" effect? Additional aid flows are used exclusively to finance an increase in public infrastructure. They find that when public infrastructure augments the productivity of private factors, and when there is an initial scarcity of public infrastructure, there are potentially large medium-term welfare gains from aid-funded increases in public investment, despite the presence of short-run Dutch disease effects of aid. In the current context of the crisis, aid might well be spent on imports not domestic consumption.

There is a large macro-econometric literature on the macro relationships amongst aid, growth and investment. Burnside and Dollar (2000) argue that aid has no identifiable additional effect on growth once other factors have been accounted for including economic policies. Aid raises growth only in countries with "good" policies. Hansen and Tarp (2001) use different econometric specifications and find that aid is effective and that the results do not depend on policy. In a number of recent studies, Rajan and Subramanian (2005 and 2007) use longer time spans and show that the impact of aid on growth is less positive. Using a large panel of countries and instrumentation strategy to correct for the bias in conventional OLS estimation, Rajan and Subramanian (2007) do not find any positive relationship between aid and growth. After analysing 97 different empirical studies on the impact of aid on growth, Doucouliagos and Paldam (2007) conclude that the impact of aid on growth is not significant. A number of factors may explain the inconclusiveness of these research efforts. Bourguignon and Sundberg (2007) argue that these mixed results are not surprising given the heterogeneity of aid motives and the complex causality chain linking foreign aid to growth.

Importantly, there are number of studies that disaggregate aid by type or category. McPherson and Rakowski (2001) use a multi-equation system and find that the impact of aid on GDP per capita growth is positive but indirect through investment. Also emphasising that aid affects growth through investment, Gomanee, Girma and Morrissey (2002) find on the basis of 25 sub-Saharan African countries over 1970-1997 that each one percentage point in the ratio of aid to GNP contributes one-third of one percentage point to growth. Clemens *et al*. (2004) split aid into different types and identify the type of aid that could plausibly stimulate growth in the short-run. They include budget and balance of payments support, investments in infrastructure, and aid for productive sectors. They find a large positive effect of this type of aid on short-term growth: a US$1 increase in aid raises the present value of output by US$8, although this effect is decreasing at the margin. By focusing the analysis on aid via investment (infrastructure, agriculture, energy efficiency), we can depart from the aid-growth conundrum by isolating the impacts of specific types of aid which have been found to be more effective. Cali and Te Velde (2008) find positive and significant effects of various types of Aid for Trade on exports and the investment climate (e.g. the costs of exporting).

Two further considerations are worth mentioning before discussing rates of return for different types of investment. First, finding $50 billion of productive investment in SSA (particularly over a short time horizon) might be difficult. It is not always easy to get new

projects off the ground. Having said this there is quite a demand for Aid for Trade projects. Secondly, the developing countries may not possess the institutional capacity to significantly scale up public spending to implement a major fiscal stimulus. We recognise these issues and suggest continued work on this should progress.

2.2 Infrastructure spending and growth

Much of the literature on the effects of infrastructure estimates rates of return using macroeconomic growth regressions. Estache (2006) suggests that *economic* returns on investment projects average 30–40 percent for telecommunications, more than 40 percent for electricity generation, and more than 200 percent for roads but when the outliers are excluded, the average is about 80 percent for roads. Returns tend to be higher in low-income than in middle income countries (see Canning and Bennathan, 2000, and Briceño and others 2004). Table 1 provides the social rate of returns on World Bank projects in infrastructure and we take this to be around 20 percent.

Table 1: Social Rates of Return on World Bank Projects

Unweighted Average 1960–2000

Region	Energy/ Mining	Telecoms & Information	Transport	Urban	Water & Sanitation
Africa	14.1	20.6	25.5	21.3	7.5
East Asia	18.3	19.5	24.8	20.3	10.5
Eastern Europe	30.9	31.1	25.8	15.7	9.8
Latin America	12.8	16.6	22.4	19.2	11
Middle East	12.3	26.9	25.1	16.5	7.8
South Asia	23.2	22	24.1	14.9	9.8
Developing World	18.4	21.5	25.4	19.2	9.2

Source: C. Briceño, Estache, N. Shafik (2004)

World Bank (2006) suggests that financial rates of return for railway concessions have been low. For Cote D'Ivoire the average annual return on equity is 9.2 percent, and for Cameroon it ranged from 14 – 22 percent. Economic rates of return would be greater than financial rates of return as it would included cost savings for those using more expensive trucking, but on the other hand investment by railways concessionaires is almost always based on loans with low interest rates from development finance institutions. Thus it seems likely that the economic rate of return of properly costed private investment in railways is not very high. A low financial rate of return is also one of the reasons for the low level of private sector investment attracted to railways over the period 1990-2004

The cross-country estimates by Esfahani and Ramirez (1999) suggest an elasticity of per capita output with respect to power generation capacity of 0.15. Deininger and Okidi (2004) examine growth and poverty reduction in Uganda during the 1990s. They also suggest that while improving access to basic education and health care is important, progress depends on complementary investments in electricity and other infrastructure. The regression for Uganda results suggest that a doubling of electricity coverage (through

a doubling in generating capacity) from 7 to 14 percent would lead to an annual increase in incomes of 3.6 percent. Such estimations suggest that the effects are not just one-off but also long-run.

Calderon and Serven (2008) provide new empirical estimates on the effects of infrastructure on growth in Africa using econometric regressions for a wider panel of 100 countries. They consider a scenario that raises the level of infrastructure development for each Sub-Saharan African country, so as to reduce by half its infrastructure gap relative to the average country in other regions in the relevant per-capita income group. They estimate the costs of being between 7 and 15 percent of GDP (reported in figure 6 in their paper), suggesting 10 percent of GDP as a rough average for sub-Saharan Africa.

The estimate of the scenario (halving the gap) for the effect on real GDP per capita also varies, between 1.2% and 2.3% per annum, and we suggest 1.5% as a rough average for sub-Saharan Africa. Costs of 10% of sub-Saharan GDP would be around US$ 80 billion. If around US$ 50 billion of infrastructure funds were added, this would be 63% of the scenario implied by Calderon and Serven. Carrying this through, 63% of a 1.5% growth rate is around 0.9% per annum permanent change in real per capita GDP. A US$ 20 billion would increase per capita growth by one third of a per cent each year.

2.3 Investment in Agriculture

The World Bank's World Development Report 2008 discusses the role of agriculture in development. It suggests that agricultural growth and poverty reduction depend critically on investments in rural infrastructure (irrigation, roads, transport, power, and telecommunications), as well as on investments in markets, rural finance, and research and extension. In Sub-Saharan Africa returns on irrigation projects now often reach 15 - 20 percent, as in the rest of the world. Evidence from rural China, India, and Uganda shows that the highest returns in growth and poverty reduction come from investments in agricultural research, rural roads, and education.

Current levels of agriculture investment in SSA are insufficient for sustained growth, NEPAD advocates a 10% increase in agriculture spending in the national budget to try to reverse that. Much of the underinvestment in agriculture is driven by mis-investment practices (spending on private goods, such as inputs subsidies).

Subsidies for agriculture are often appropriated by the richest farmers; the quality (efficiency and equity) of the scarce resources spending is often more of a fundamental issue than the level of spending itself. Subsidies can be good complementary policies, as they can help overcome immediate constraints from market failures (as part of a broader strategy), offset costs of infrastructure and reduce risk. But most frequently subsidies have been used for different purposes, in detriment of high potential returns from investment in public goods (as fiscal resources are scarce). In Zambia, where 37 percent of the agricultural budget is spent on fertilizer subsidies, only 15 percent of the 2003/04 budget was spent on research, extension services, and rural infrastructure—investments that have shown high payoffs. In order to improve the spending efficiency and equity of

public resources, political economy pressures on the budget allocation need to be addressed. Economic sectors/interest groups that gather higher proportions of national wealth often have the means to influence policies in their favour. A strategy to deal with this issue is to strengthen the voice of a wider group of stakeholders, particularly small holders, and provide gains of transparency and accountability.

Allston *et al* (2005, table 17) summarise 683 rate of return studies on agriculture research spending. They suggest that agricultural research and extension tend to generate the highest returns of any form of agricultural spending, suggesting that the returns to agricultural research average 50% in Africa, 78% in Asia and 53% in Latin America although variability of outcomes is high especially in Africa.

Fan *et al*. (2004) provide information for returns of different spending categories on agriculture output by region in Uganda. They suggest that one shilling invested in feeder roads will result in agriculture output of 7.2 shillings for Uganda as a whole, less than agriculture R&D (12.4 shillings) but much more than education (2.7 shillings) and health (0.9 shillings). For further details on output increases as a a result of agriculture spending more see Table 2. Rates of return will depend on the efficiency of spending which depends on political drivers.

Table 2 Returns to Investment in Agricultural Public Goods

Spending category	China	India	Thailand	Uganda	Viet Nam
Research	9.6	13.5	12.6	12.4	12.2
Irrigation	1.9	1.4	0.7	0.4	
Roads	2.1	5.3	0.9		3
Electricity	0.5	0.3	4.9		
Education	3.7	1.4	2.1	2.7	2.1

Returns = $ increase in agricultural output per $ of incremental spending,
Source: Fan *et al*. (2004)

2.4 Green investment

Many researchers suggest that rules and institutions that promote investing in energy efficiency also help productivity enhancements vital to promote development and reduce poverty (see, for example, Porter and van der Linde, 1995). They argue that energy efficiency improvements provide a means to reduce costs without adversely affecting output or eroding a firm's competitive edge. In addition, energy efficiency is also considered to reduce the unpredictability of earnings associated with the current volatility of energy prices in the present day world economy.

Another hypothesis is that investing in technical change may automatically lead to greater energy efficiency if this incorporates the latest, more energy efficient techniques (Inhaber 1997; Huber and Mills 2005). This trend is referred to as the 'autonomous energy

efficiency improvement technological change'. For example, Hogan and Jorgenson (1991) estimate that technological change alone caused a reduction in the US energy intensity by about 0.3 percent per year, independent of changes in energy prices or standards. Koopmans and Te Velde (2001) find that energy efficiency improved by 1.1 percent a year in the Netherlands. There is however very limited evidence available for developing countries on the link between energy efficiency and technical change, although the issue is becoming increasingly important for them. Te Velde (2008) suggests that productivity and energy inefficiency in China are negatively related implying that greater productivity leads to higher energy efficiency. He also finds a positive but insignificant effect of physical capital intensity on energy efficiency.

Many stimulus programmes to combat the current global financial crisis have green elements. For example, 69% of the US$ 38.1 billion stimulus in South Korea would go to green investments, 34% of the US$ 581.2 billion in China but 0% of the US$ 6.8 billion in India. In the US the green stimulus would create 2 million jobs by investing in four energy efficiency and renewable energy strategies:

- Retrofitting buildings to improve energy efficiency
- Expanding mass transit and freight rail
- Constructing a "smart" electrical grid transmission system
- Developing renewable energy, i.e. wind power, solar power, next-generation biofuels and other bio-based energy.

Only 2.3% of the projects of the Clean Development Mechanism go to Africa. A UNEP report (a Global Green New Deal, from February 2009) suggests around one third of the US$ 2.5 trillion worth of planned stimulus packages should be invested on 'greening' the world economy to assist in powering the global economy out of recession and onto a Green, 21st century path. Stern suggests around 20% of the stimulus should go to environment. There is no general study on the relationship between growth and energy efficiency in developing countries.

2.5 Conclusions for sub Saharan Africa and the rest of the World

This brief literature survey suggests that investment infrastructure can increase growth in sub-Saharan Africa and that aid can support this process through faster investment and especially Aid for Trade or increased budget support. Studies suggest that social rates of return are around 20% for investment in infrastructure.

Further we should also emphasise that we live in an interdependent world and that growth in Africa is also good for others. The benefits of faster growth in Africa are non-economic (less conflict and more stability, fewer communicable diseases, etc) but also economic. There is for instance a relationship between bilateral aid and bilateral exports, not because aid is tied but because aid can lead to additional growth and imports. Te Velde and Massa (2008) estimate the effects of bilateral aid loans and aid grants on exports based on a sample panel of all DAC providers of aid and all DAC developing

country receives over the period 1980-2006, taking into accounts fixed country effects as well as other normal determinants of bilateral trade such as GDP, trade, distance and language ties (see the appendix for regression results).

According to the estimation a 100% change in bilateral aid grants leads to a 1.7% increase in bilateral exports from that country. In 2006 (according the OECD DAC and IMF DOTS database), UK bilateral aid was US$ 3.2 bn in 2006, and UK exports were US$ 27 bn in 2006. A 100% change in aid (from 3.2 to 6.4 USD bn) would lead to a US$ 475 mn change in exports from UK to developing countries. Thus for every US$6.7 a country provides in bilateral aid grants it receives US$ 1 in bilateral export revenues

The rest of this paper describes how a fiscal stimulus in SSA financed by aid could help SSA and also the rest of the world.

3 Policy scenarios

This paper suggests that 1 per cent of the G-20 fiscal stimulus can be directed towards sub-Saharan Africa with the aim to offset the impact of the global financial crisis in that region. This amounts to approximately $20 billion, or 2.2 per cent of sub-Saharan African GDP in 2008.

A larger fiscal stimulus to sub-Saharan Africa can be justified by the costs that the region has sustained as a result of the global financial crisis. To estimate the impact of the financial crisis on sub-Saharan Africa, we compare NIESR projections for real GDP in the region produced in January 2009 to a "pre-crisis" scenario based on information available to August 2008. This suggests that the global financial crisis has reduced growth prospects in sub-Saharan Africa by 4-5 per cent per annum in 2009 and 2010, or roughly $40 billion per annum.

Both the short-term and long-term impacts of a fiscal stimulus to sub-Saharan Africa will depend not just on the size of the stimulus itself, but on how the money is spent. There are essentially three different ways in which the fiscal stimulus can be enacted.

- The first scenario treats the funds as debt relief and reduces the stock of foreign debt. This has no immediate impact on domestic demand in the economy, but its effects on demand will build up as it will reduce the outflows from sub-Saharan Africa to finance the stock of foreign debt.

- The second scenario is to use the funds to finance current consumption. For example, to shore up social protection schemes as economic conditions deteriorate. This has a noticeable direct impact on domestic demand, and will support growth in the short-term.

- The third scenario is to use the funds to finance productive investment, to raise the long-run productive capacity of the economy. This has a direct impact on domestic demand in the short-term, and also raises the level of potential output in the long-run, so that we are not simply shifting output forward from subsequent years.

- As a final scenario, it may be possible to direct the investment expenditure in a way that speeds productivity growth and the process of convergence on a longer term basis. Calderon and Serven (2008) suggest that investment in infrastructure can raise productivity growth for a sustained period in sub-Saharan Africa, speeding the process of technology adoption from the advanced economies. If this can be done, World Bank studies suggest that there may be a social rate of return of 20 per cent on top of the capacity effects in the previous scenario.

4 Model estimations

In order to assess the impact of the different approaches to fiscal expansion, we have run a series of model simulations, using NIESR's global econometric model, NiGEM. Most of the OECD countries are modelled separately within NiGEM, as are China, Russia, Hong Kong, Taiwan, Brazil, Estonia, Latvia, Lithuania, Slovenia, Romania, Bulgaria and South Africa. The rest of the world is modelled through regional blocks, and the results presented in this paper are based on the NiGEM regional block for Africa (see Appendix for details). All country and regional models in NiGEM contain the determinants of domestic demand, a supply side, export and import volumes, prices, current accounts and net assets. Economies are linked through the effects of trade and competitiveness and are fully simultaneous. There are also links between countries in their financial markets as the model describes the structure and composition of wealth, emphasizing the role and origin of foreign assets and liabilities.

As discussed above, we estimate that the global financial crisis has reduced the prospects for growth in sub-Saharan Africa in 2009 and 2010 by about 4-5 percentage points per annum. This is before taking into account any of the fiscal stimulus packages that have recently been announced in the G-20 economies. However, the planned fiscal packages will have significant spillover effects on sub-Saharan Africa, and will partially offset the anticipated negative impact of the financial crisis on African exports.

We have incorporated the following fiscal packages from the G-20 economies into our model simulations, the bulk of which affect budgets in 2009 and 2010:

- A US fiscal expansion worth $797 billion, about 75 per cent of which will come through higher spending and 25 per cent of which will come through lower taxes.
- A fiscal expansion in Japan amounting to $110 billion, the bulk of which comes through higher consumption spending.
- Fiscal expansion in the Euro Area worth $270 billion, with by far the biggest stimulus affected in Germany.
- A fiscal package in Canada worth $33 billion.
- A UK fiscal expansion worth $22 billion.
- A fiscal expansion in China amounting to $586 billion.

Together, these fiscal packages are expected to raise growth in sub-Saharan Africa by 1-1½ per cent per annum in 2009-2010, offsetting about 25 per cent of the impact of the financial crisis on the region. The level of GDP is just over 1 per cent higher in 2009 than without the fiscal stimulus, and about 2½ per cent higher in 2010. Exports from the region will be nearly five per cent higher than they would be in the absence of these fiscal packages. This gradually spills over into domestic demand, which is about 2 per cent higher in 2010 than it would have been in the absence of the fiscal packages.

Figure 1 Impact of current G-20 fiscal packages on the level of GDP in sub-Saharan Africa
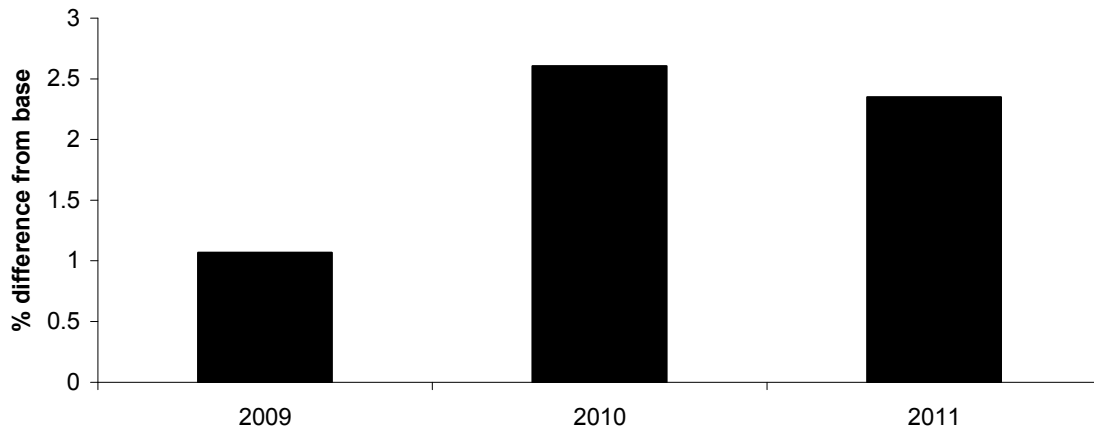
On top of the G-20 fiscal expansions illustrated in the figure above, we consider a direct fiscal expansion in Africa, financed through aid flows from the developed economies. We first consider a fiscal stimulus of $20 billion, in line with the current call for 1 per cent of global fiscal stimuli to be directed towards sub-Saharan Africa. In this simulation we assume the stimulus is spent on current consumption, to support social safety net programmes. The package is financed by the G7 economies, with costs distributed across countries according to the size of their domestic fiscal packages (57 per cent financed by the US, 12 per cent financed by Japan and Germany, respectively, 8 per cent financed by France, 6 per cent financed by Italy, 3 per cent financed by Canada and 2 per cent financed by the UK). Figures 2-7 below illustrate the impact on the level of GDP in sub-Saharan Africa on top of the spillover effects on growth of the agreed G-20 domestic fiscal expansions.

Figure 2 Impact of $20 billion stimulus to consumption on the level of GDP in sub-Saharan Africa
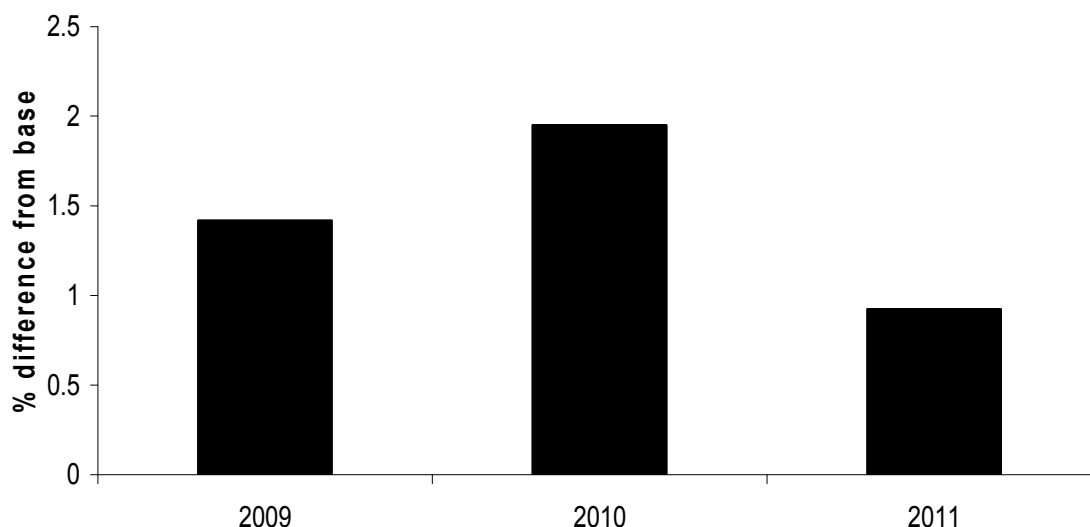
A $20 billion fiscal stimulus spent on consumption raises growth by 1.4 percentage points in 2009 and 0.5 percentage points in 2010, bringing the level of GDP about 2 per cent above base in 2010. The productive capacity of the economy is unchanged in this scenario, so in the long-run the level of GDP is unchanged[2]. As a result, GDP growth will be somewhat lower in 2011-2013, as the level of GDP returns to its pre-stimulus (and pre-crisis) baseline.

Taken together, the developed countries' domestic fiscal stimuli and a $20 billion sub-Saharan Africa stimulus spent on current consumption offset about half of the impact of the global financial crisis on GDP growth in sub-Saharan Africa in 2009 and 2010 (4-5% per annum). This still leaves a significant gap in GDP, which could be filled by increasing the size of the stimulus package.

The following sets of simulations increase the size of the stimulus package to $50 billion. The financing of the package is distributed according to the same proportions above, with the bulk of spending coming in 2009. We consider each of the policy scenarios described in the previous section.
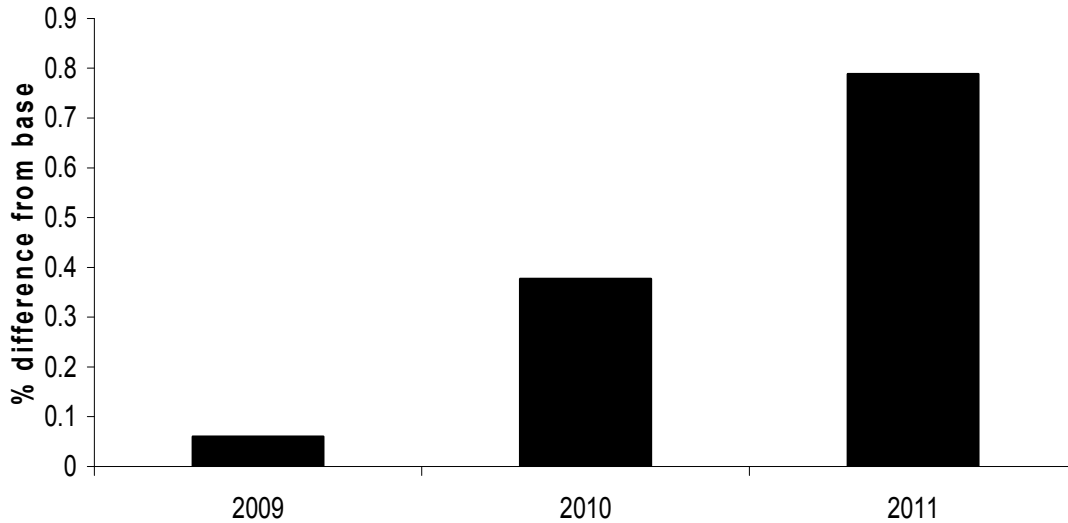
In the first scenario, the fiscal stimulus is treated purely as debt relief. This has a very modest positive impact on growth over the next few years, does little to offset the sharp slowdown attributable to the financial crisis, but the growth effects build up over time. Debt relief reduces outflows from sub-Saharan Africa to finance debt payments, leaving income for spending on the domestic economy. The impact is small, and builds up gradually over a few years, with the level of GDP expected to be about 0.8 per cent

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[2] While the level of GDP is unchanged in the long-run, the level of GNP will remain somewhat elevated, as net interest payments abroad to finance external debt will be lower.

higher than it would have been in the absence of debt relief in 2011. This is not a useful channel for offsetting the short-term impact of the financial crisis on output.

Figure 3 Impact of $50 billion debt relief on the level of GDP in sub-Saharan Africa
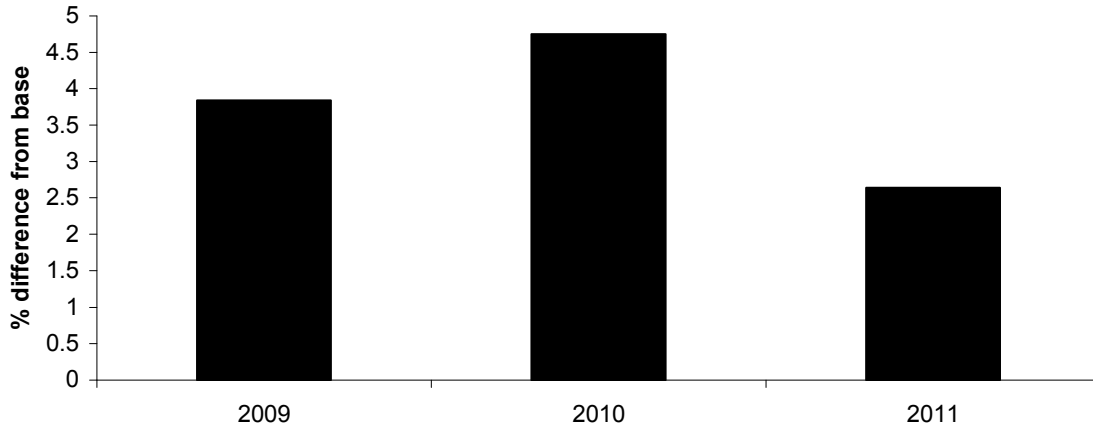

In the second scenario, the fiscal stimulus is affected through current consumption through social safety nets and the like. In this case, there is a strong impact on GDP growth in 2009, bringing the level of output back towards where it might have been in the absence of the financial crisis. As discussed above, the productive capacity of the economy is unchanged in this scenario, so in the long-run the level of GDP will return to its pre-stimulus base, implying lower growth for a few years.

Figure 4 Impact of $50 billion consumption stimulus on the level of GDP in sub-Saharan Africa
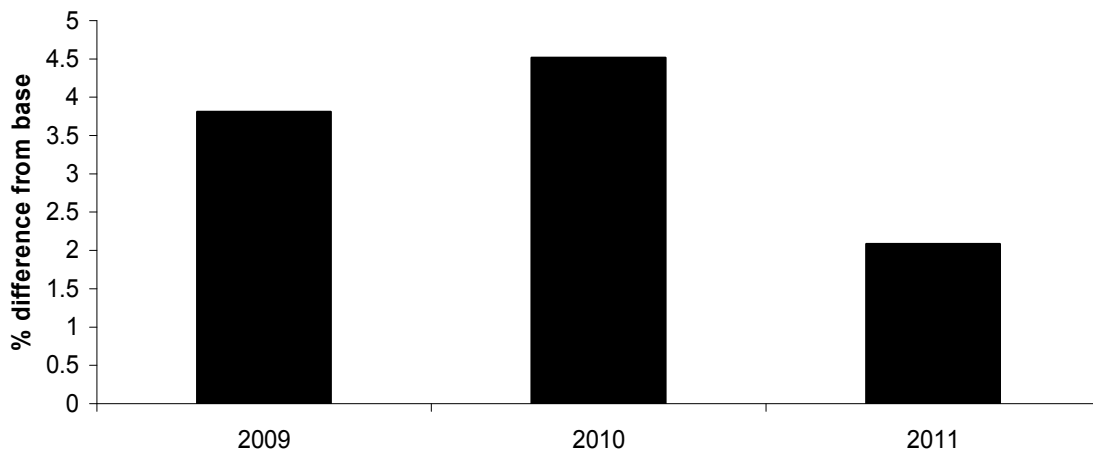
In the third scenario, the fiscal stimulus comes in the form of productive investment, raising the productive capacity of the economy permanently. The short-term impact on output is in line with the previous scenario. However, in the longer-term, the level of output remains 1½ per cent higher than it would otherwise have been. This allows positive long-term spillovers to the rest of the world as well.

Figure 5 Impact of $50 billion investment stimulus on the level of GDP in sub-Saharan Africa

In the final scenario, the fiscal stimulus comes in the form of investment in infrastructure, which is assumed to raise the speed of the adoption of technology from the advanced economies, allowing faster productivity growth for 5 years and assuming a 20% social rate of return on investment in infrastructure. The impact on GDP growth in the first three years is very similar to that of the previous simulation. However, the long-run level of GDP is higher in this scenario, with a permanent increase in the level of output of 2½ per cent.

Figure 6 Impact of $50 billion infrastructure investment stimulus on the level of GDP in sub-Saharan Africa with productivity spillovers
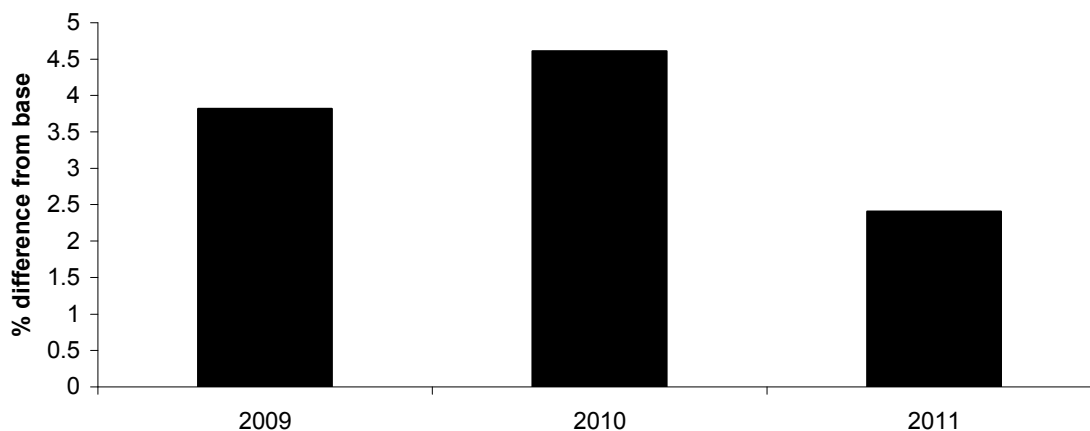
The impact of the three last scenarios on growth in the first three years is very similar, and in all cases is more or less is sufficient to offset the impact of global financial crisis on sub-Saharan African output in 2009, offsetting more than 85 per cent of the impact of the crises. In fact, these simulations slightly overshoot the pre-crisis level of output in 2009, and some fine tuning could shift some of this stimulus from 2009 into 2010 to smooth the outlook further.

The long-run impacts of the different fiscal scenarios do differ, and in the figures below we plot the impact on the level of GDP of the fiscal scenarios until 2021 to illustrate this difference. In the long-run, the level of output is close to base when the fiscal expansion finances current consumption. However, when the fiscal expansion is enacted through investment, there is a permanent rise in the potential output in the economy. The level of output is 1.6 per cent higher in the long-run than when the funds are spend on current consumption. If there are additional social spillovers associated with infrastructure investment, this may raise the long-run level of output by a further 1 per cent. Financing productive investment, and in particular productivity enhancing infrastructure investment, could help sub-Saharan Africa move towards the United Nation's Millennium Development Goals

Figure 7 Impact on sub-Saharan African GDP of $50 billion fiscal expansion in sub-Saharan Africa
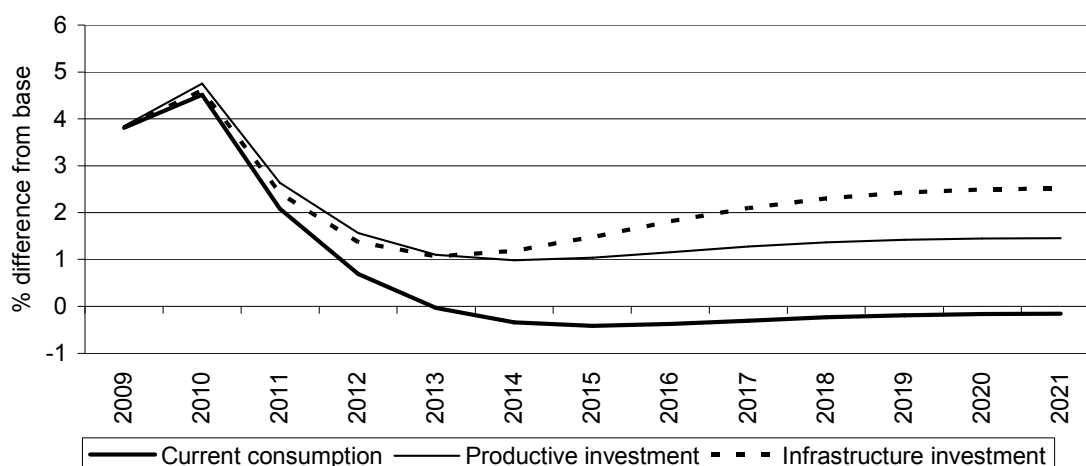

Table 3 summarises the findings discussed above, in terms of the growth rates of real GDP expected for sub-Saharan Africa under the various scenarios. Under a pre-crisis scenario, real GDP in sub-Saharan Africa could have been expected to rise by about 6½ per cent per annum 2008-2010. The crisis has reduced prospects significantly, with growth expected to be just 1¾ - 2¼ per cent per annum 2009-2010. Announced fiscal packages in the G-20 economies will offset some of this loss, raising the prospects for growth to about 3¼ per cent per annum in these years. On top of this a fiscal stimulus of $20 billion raises growth to average 4.2 per cent in the two years, while a fiscal expansion of $50 billion raises growth to average 5.6 per cent in the two years, largely offsetting the impact of the financial crisis on sub-Saharan Africa.

Table 3 Summary of growth projections for sub-Saharan Africa [a]

	2007 (current prices US$)	2008 (real growth %)	2009 (real growth %)	2010 (real growth %)	Long-run impact
Pre-crisis	855.8	6.5	6.5	6.5	Base
Post-crisis		5.4	2.2	1.7	Returns to base
G-20 fiscal packages			3.3	3.2	Returns to base
$20 bn debt reduction			3.3	3.3	Returns to base
$20 bn consumption			4.7	3.7	Returns to base
$20 bn investment			4.8	3.8	Increased by 0.6%
$20 bn infrastructure			4.7	3.8	Increased by 1%
$50 bn debt reduction			3.4	3.5	Returns to base
$50 bn consumption			7.2	3.9	Returns to base
$50 bn investment			7.2	4.1	Increased by 1.4%
$50 bn infrastructure			7.2	4.0	Increased by 2.5%

a Growth rates for the $20 billion and $50 billion fiscal expansions in sub-Saharan Africa also include the spillover impact of currently agreed fiscal programmes in the G-20 economies.

A fiscal expansion in sub-Saharan Africa financed by the developed economies does necessarily entail some costs to the financing countries. However, these costs are small relative to the size of the economies, and are at least partially offset by higher exports from the financing countries to sub-Saharan Africa. The size of the offset will differ across countries, depending on the openness of the economies and the exposure of their export markets to sub-Saharan Africa. In 2003, less than 1 per cent of US exports were directed towards sub-Saharan Africa, while more than 4 per cent of Euro Area exports were directed towards the region. Figure 8 illustrates the impact of a $50 billion fiscal expansion used to finance investment in infrastructure in sub-Saharan Africa on export volumes emanating from the financing countries. Exports rise in all countries in the first two years, at least partly offsetting the costs to domestic demand.

Figure 8 Impact of sub-Saharan Africa fiscal expansion spent on infrastructure on the level of export volumes in financing countries[3]
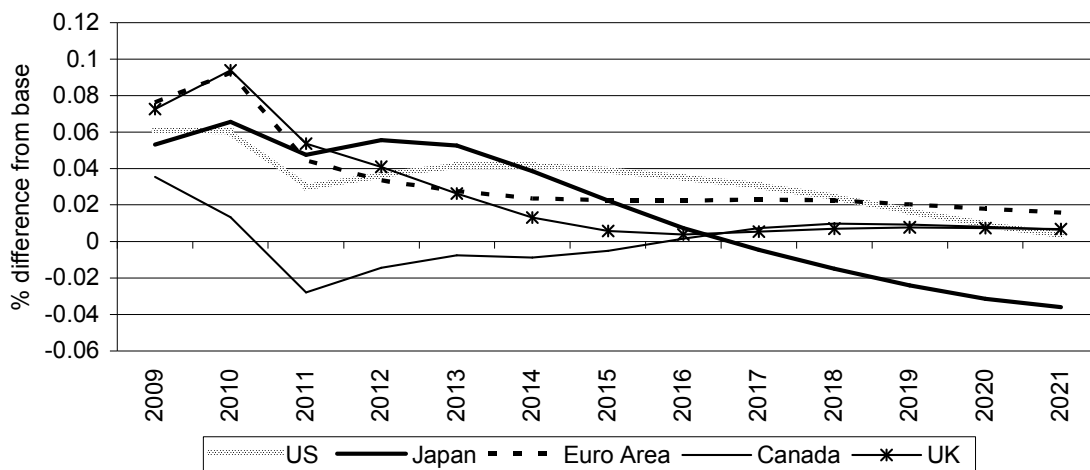
In Table 4 below, we tabulate the costs and benefits to the financing regions, and also to the world as a whole and China, of the $50 billion simulation of investment in infrastructure in sub-Saharan Africa, entailing productivity spillovers. Taking the UK as an example, we find that while it spends US$1 billion on the SSA fiscal stimulus it get US$0.7 billion back in the form of exports in the first year. If the UK can persuade G20 countries to contribute a fixed percentage to a stimulus in SSA there will be a 20% rate of return on its own investments (0.011% net GDP impact compared to a 0.05% of GDP investment) in 2009. The number has to be treated with caution because it depends on a particular allocation in contributions to the fiscal stimulus.

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[3] The impact on Canada is small and even negative for a few years, reflecting both the low exposure of Canadian exporters to Africa and their high exposure to the US, which bears the highest share of the costs.

Table 4 Impact of sub-Saharan Africa fiscal expansion on financing countries in 2009

	Direct costs	Additional exports	Net impact on real GDP
US	$28.5 bn (0.20% of GDP)	$1.4 bn	+0.003%
Japan	$6 bn (0.11% of GDP)	$0.6 bn	+0.005%
Germany	$6 bn (0.18% of GDP)	$1.8 bn	+0.007%
France	$4 bn (0.15% of GDP)	$1.6 bn	+0.025%
Italy	$3 bn (0.14% of GDP)	$0.7 bn	+0.007%
Canada	$1.5 bn (0.12% of GDP)	$0.3 bn	+0.006%
UK	$1 bn (0.05% of GDP)	$0.7 bn	+0.011%
China		$1.4 bn	+0.016%
World		$20.4 bn	+0.073%

In 2009, the impact on output in all the financing countries is positive, but very small. The slight rise in exports is partly offset by lower domestic demand to finance the additional aid to sub-Saharan Africa, and this negative impact on domestic demand increases in 2010 and 2011. Nonetheless, the impact remains imperceptibly small, and would not materially affect the outlook for GDP growth in any of the financing economies. In the long-run the level of GDP is slightly above base in all countries, reflecting a permanent rise in global productive capacity.

The essentially negligible size of the impact on financing countries is an important finding, as the positive impact on the African economy is substantial, at little cost to the financing economies. If rising unemployment were to provoke social unrest, the negative impact on sub-Saharan Africa of a recession may prove significantly higher than our economic model can capture, implying that the benefits of stabilizing growth in the region may far outweigh the estimates presented here.

The figures reported in the table above show that some countries benefit from a stronger Africa more than others, and it would be possible to design a financing package that entails a slightly more equitable impact across countries. For example, there is an argument for France and the UK, and possibly even China, financing a slightly higher proportion of the package, as they reap the greatest benefits. However, it must be born in mind that the impact of the aid package on the financing countries is so small, that the time and effort required to design a more equitable package may prove more costly than it is worth.

Another important factor to bear in mind is that for the fiscal package to be fully effective, the funds must be spent in a productive manner that helps to maintain employment levels in the short-term and also increases the productive capacity of sub-Saharan Africa over the longer-term. It can be difficult to design appropriate spending plans in a short period of time, as it takes time and research to determine how the funds can most usefully be spent.

5 Conclusions

The global financial crisis will have a major impact on development. We suggest that the output loss of the global financial crisis for sub-Saharan Africa (SSA) alone is around US$ 40 – 50 billion in 2008-2009. Developed countries have announced fiscal packages worth close to US$ 2 trillion to address the effects of the global financial crisis – the effects of these packages help to smooth income losses in SSA in 2009-2010, offsetting about a quarter of losses due to the financial crisis.

Developed countries can also support a fiscal stimulus in developing countries through increased aid. The literature suggests that productive investment in infrastructure increases growth in developing countries and specifically SSA. and the results in this paper confirm that further infrastructure spending raises growth for a sustained period.

We use a quarterly macroeconomic model (NIESR's NIGEM) to simulate a US$ 20 and a US$ 50 billion fiscal expansion in SSA. Both are illustrative and chosen because respectively $50 billon is approximately the output loss to SSA caused by the series of exogenous shocks initiate by the GFC; and $20 billion is approximately 1% of the $2trillion sum of all national stimulus packages in developed and emerging economies. Taken together, the developed countries' domestic fiscal stimuli and a US$ 20 billion sub-Saharan Africa stimulus spent on current consumption can offset about half the impact of the global financial crisis on GDP growth in sub-Saharan Africa in 2009 and 2010. In turn increasing growth in SSA by some 2% in 2009-2010. This still leaves a significant gap in GDP, which could be filled by increasing the size of the stimulus package to around US$ 50 billion. .

If US$ 50 billion goes to debt relief in SSA, the initial growth effects are small. If the stimulus is spent on consumption (income transfers, social safety nets etc) it can smooth income losses and increase incomes by 4% in 2009 and a further 1% in 2010. If the stimulus goes to productive investment there is a similar income smoothing effect over the short term. In addition there is a long-term positive impact on the level of output, which remains about 1.5% higher, while other stimuli do not shift the long-run level of potential output.

A stimulus in SSA of US$ 50 billion has positive effects on global trade, and world GDP would be 0.1% higher in 2009-2010 as a result (this is equivalent to US$44 billion world wide, and of this around 15% or USD 6 billion goes to the rest of the world outside SSA) . US and Chinese exports would increase by about US$1.4 billion in 2009; German exports would increase by about US$1.9 billion and UK exports by US$ 0.7 billion If the UK can persuade other G-20 countries to contribute a fixed percentage to a stimulus in SSA there will be a 20% rate of return on its own investments (0.011% net GDP impact compared to a 0.05% of GDP initial investment). The overall rate of return of the US 50 billion stimulus to the rest of the world is around 15%.

Assuming that it is possible to find US$ 50 billion of productive investment in SSA infrastructure, and based on the rates of return we have seen in the past for infrastructure projects, and that funds are provided in the form of well managed aid with capable local institutions implementing the investment, the simulations on the model suggest world output would increase by US$ 250 billion, with much of it in sub-Saharan Africa, and around $20 billion in the rest of the world. The cumulative impact after 10 years of a fiscal stimulus in consumption is around US$ 60 billion in world GDP.

The infrastructure investment scenario would "pay for itself" by 2016, in the sense that world output outside the SSA does not fall below baseline after that point. However, US GDP remains below base until 2018 and UK GDP remains below base until 2023, so not all the funders recover at the same speed. After 5 years, in the infrastructure investment scenario, Euro Area export volumes have increased by a cumulative $12.9 billion; of which $3 billion is in Germany. UK export volumes have increased by a cumulative $1.5 billion and US export volumes by $3.6 billion.

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Appendix A: Details of model for Sub-Saharan Africa in NiGEM

The model simulation results reported in this paper are based on the behaviour of NiGEM's regional model of Africa. There are a few technical factors to consider in the interpretation of the results.

Country composition

NiGEM's model of Africa consists of the following countries:

Angola	Ethiopia	Namibia
Benin	Gabon	Niger
Botswana	Gambia, The	Rwanda
Burkina Faso	Ghana	São Tomé and
Burundi	Guinea	Príncipe
Cameroon	Guinea-Bissau	Senegal
Cape Verde	Kenya	Seychelles
Central African	Lesotho	Sierra Leone
Republic	Madagascar	Sudan
Chad	Malawi	Swaziland
Comoros	Mali	Tanzania
Congo, Dem. Rep. of	Mauritania	Togo
Congo, Rep. of	Mauritius	Tunisia
Côte d'Ivoire	Morocco	Uganda
Djibouti	Mozambique, Rep. of	Zambia
Equatorial Guinea		

Nigeria is in OPEC and Morocco on Africa. In order to apply this model to illustrate a shock to sub-Saharan Africa, we have to make the assumption that on average the behaviour of included/excluded economies, in terms of price and demand elasticities and speed of response, is in line with that of the rest of the region. While this may prove a strong assumption, the level of GDP for NIESR's African region plus South Africa shows less than a 10 per cent deviation from the IMF's sub-Saharan Africa definition historically.

PPPs versus exchange rates

For regional aggregations, the NiGEM model sums together real GDP data levels in terms of purchasing power parities, rather than current exchange rates. This corrects for price level differences across countries and more accurately captures the size of an economy relative to the rest of the world. However, this makes it less straightforward to apply an absolute transfer in US$ terms from one country to another. In order to account for this, we calculate the size of the shock (i.e. $50 billion) as a share of nominal domestic demand in current US$. We then raise domestic demand by an equivalent

percentage, to capture the buying power of $50 billion in sub-Saharan Africa. In percentage terms, the results are straightforward to interpret. However, some care must be taken when converting these impacts into level terms.

Key model relationships

Aid inflows into Africa enter the economy through balance of payment transfers. This is assumed to improve the current account balance, and reduces the stock of net foreign debt. A decline in net foreign debt has a positive impact on domestic demand in Africa, which in turn raises African import demand and hence global exports to Africa.

If aid inflows are treated as debt relief, the shock simply entails a rise in balance of payment inflows to Africa, matched by a rise in outflows from the financing countries. If this is financed by government borrowing in the financing countries, the budget deficit widens by the same amount, and this will entail an offsetting rise in tax rates in the financing countries to maintain solvency. Meanwhile there is a small rise in domestic demand in Africa as the net stock of foreign debt declines, leading to a rise in global exports to Africa, which at least partly offsets the negative impact on domestic demand of financing costs.

If aid inflows are spent on either consumption or investment, this also involves a direct shock to domestic demand in Africa, and hence a more significant rise in African import demand and global exports.

If aid inflows are spent on investment, this raises the level of capacity output, entailing a direct shock to capacity output. This feeds into the rest of the economy through the price system, as prices adjust to equate actual output (demand) with potential output (supply).

If aid inflows are spent on infrastructure, and this has productivity spillover effects, this entails an additional shock to the level of technical progress in Africa, speeding the approach to the technology frontier. This raises capacity output, and feeds into the rest of the economy through the price system as described above.

Some of the key equations on the model are described below:

AFCBV Current balance, US$ Mn

#i **afcbv=** afbpt+afxval -afmval+afipdc-afipdd

where afbpt are balance of payment transfers, afxval is African exports in US$, afmval is African imports in US$, afipdc is interest payments received by Africa, afipdd is interest payments paid by Africa.

AFPXCOM Price of commodity exports, US$, 2000=100

afpxcom = 0.04873*wdpmm + 0.251114*wdpanf +

#0.042418*wdpfdv+0.32965*wdpfld
+ 0.328086*wdpo

where wdpmm is the price of metals and minerals, wdpanf is the price of agricultural non-foods, wdpfdv is the price of food, wdpfld is the price of beverages and wdpo is the price of oil.

AFPXNCOM Price of non-commodity exports, US$, 2000=100

log(afpxncom)= log(afpxncom(-1)) + 0.136269

- 0.173991*(log(afpxncom(-1)) - 0.442582*log(afcpx(-1))

- (1.-0.442582)* log(afcedd(-1)))

+ 0.105890* log(afpxncom(-1)/afpxncom(-2))

+ (1.-0.105890)* log(afcpx(-1)/afcpx(-2))

where afcpx is competitor's export prices, afcedd is domestic prices in US$ terms.

AFPX Deflator, exports of goods and serv, US$, 2000=100

#i **afpx =** 0.27694*afpxcom + (1.-0.27694)*afpxncom

AFDD Domestic demand, US$ Bn, 2000 prices

log(afdd) = log(afdd(-1))
+ 0.451 - 0.132189*(log(afdd(-1))
- 0.60*log(afxvold(-1))
+ 0.0059783*afnar(-1))
+ 0.5*log(afpopt/afpopt(-1))

where afxvold is African export volumes in terms of domestic consumer prices, afnar is net foreign debt as a share of GDP, and afpopt is total population.

26

AFMVOL Imports of goods and servs, Bn US$, 2000 prices

log(afmvol)= log(afmvol(-1))- 0.284631
- 0.092493*(log(afmvol(-1)) + 0.68077*log(afrpm(-1))

- 1.24*log(afdd(-1)+afxvol(-1)))

+ 1.1*log((afdd+afxvol)/(afdd(-1)+afxvol(-1)))

-0.06147*log(afrpm/afrpm(-1))

where afrpm is import prices relative to domestic prices.

AFXVOL Exports of goods and servs, Bn US$, 2000 prices

log(afxvol) = log(afxvol(-1)) +0.11185
-0.172654*(log(afxvol(-1)) +1.350605*log(afrpx(-1))
-1.0*log(afs(-1)))
+1.08*log(afs/afs(-1)) -0.268*log((afrpx)/(afrpx(-1)))

where afrpx is African export prices relative to competitor's, afs is external demand.

AFY GDP, US$ Bn, 2000 PPP

#i **afy =** afdd + afxvol - afmvol

AFCED Consumer expenditure deflator, 2000=100

log(afced)= log(afced(-1))+ 0.001774

-0.02545*(log(afced(-1))-log(afpmd(-1))-1.490*afog(-1))
+ 0.201981*log(afpmd/afpmd(-1))
+ 0.106133*log(afpmd(-1)/afpmd(-2))
+ (1.-0.201981-0.106133)*log(afinf)
+0.22897*(afog-afog(-1))

where afpmd is import prices in domestic currency, afog is the output gap
(afy/afycap), afinf is inflation expectations.

AFYCAP Trend output for capacity utilisation

log(afycap) = log(afycap(-1)) - 1.566 - 0.2*(log(afycap(-1)) - aftechl
- log(afpopt(-1)))

where aftechl is the level of technical progress and afpopt is total population.

Appendix A: Bilateral Aid and Trade Relationships

Bilateral aid leads to more exports without aid being tied. Massa and Te Velde (2008) estimate

$$\ln(Exp_{ijt}) = \alpha + \beta_1 \ln(Y_{it}) + \beta_2 \ln(Y_{jt}) + \beta_3 \ln(Ypc_{it}) + \beta_4 \ln(Ypc_{jt}) + \beta_5 \ln(Dist_{ij}) + \beta_6 X_{ijt} +$$
$$+ \delta_3 \ln(Grants_{ijt}) + \delta_4 \ln(Grants_{All-i, jt}) + \varepsilon_{ijt}$$

where i stands for the exporting country (donor), j for the importing country (recipient) and t for the time span. The dependent variable Exp_{ij} represents the export flows from country i to country j. Among the explanatory variables, Y measures the gross domestic product of country i and j respectively, Ypc stands for the GDP per capita of each of the two countries, $Dist_{ij}$ is the distance between the exporting and importing country, and X_{ij} is a vector which usually includes dummies indicating whether the two countries share a common border, a common language or other. ε_{ij} is the error term, normally distributed, with mean 0 and variance σ_ε^2.

$Grants_{ij}$ and $Grants_{All-i,j}$ are respectively the grants country j receives from country i, and the grants country j receives from all the countries other than country i.

The vector X_{ij} in equation includes the following set of dummy variables commonly used in the international trade gravity model literature:

- *Colony* which is a binary variable taking value 1 if one country in the trade pair was colonized by the other, and 0 otherwise;
- *Comlang* which is a binary variable taking value 1 if the two countries have a common language, and 0 otherwise.

Variable description

Variables	Number of Observations	Definition	Sources
Exp_{ijt}	1688	Exports from country i to j in real terms in USD	IMF
Y_{it}	1688	GDP of country i in real terms in USD	WDI
Y_{jt}	1688	GDP of country j in real terms in USD	WDI
Ypc_{it}	1688	GDP per capita of country i in real terms in USD	WDI
Ypc_{jt}	1688	GDP per capita of country j in real terms in USD	WDI
$Grants_{ijt}$	1688	Grants disbursed in real terms in USD	OECD
$Grants_{All-i, it}$	1688	Grants from all the countries other than country i in real terms in USD	OECD
$Loans_{ijt}$	1688	Loans disbursed in real terms in USD	OECD
$Loans_{All-i, it}$	1688	Loans from all the countries other than country i in real terms in USD	OECD
$Dist_{ij}$	1688	Distance between country i and j	CEPII
$Colony_{ijt}$	1688	Dummy for a previous colonial relationship	CEPII
$Comlang_{ijt}$	1688	Dummy for common language	CEPII

Note: The dataset covers the period 1980-2006.

Table The effects of bilateral aid (disbursements) on bilateral trade, 1980-2006.

Dependent Variable: Exp_{ijt}	Fixed Effects	Random Effects
	(6)	(7)
Y_{it}	-1.74	0.820***
Y_{jt}	2.267***	0.907***
Ypc_{it}	1.696	-0.450*
Ypc_{jt}	0.251	0.350***
$Grants_{ij,t}$	0.017*	0.020***
$Grants_{All-i,it}$	-0.014	-0.021
$Dist_{ij}$		-1.007***
$Colony_{ijt}$		0.818***
$Comlang_{ijt}$		0.609***
$Constant$	127.142***	37.436***
N	1688	1688
N_g	319	319
R^2_within	0.280	0.248
$R^2\_overall$	0.408	0.783
$R^2\_between$	0.226	0.774

Note: All variables in natural logarithms. Legend: * significance at 10 percent **significance at 5 percent *** significance at 1 percent. All regressions include a time trend not reported. Source Massa and Te Velde (2008)