Key Characteristics of the Rising Sino-Africa Cooperation: A Game With Hidden Strategies?

John M. Ulimwengu & Malokele Nanivazo

Résumé

Les données disponibles montrent que les pays disposant des réserves de pétrole ainsi que de ressources minières sont susceptibles d'obtenir plus d'investissements directs étrangers et d'assistance financière de la part de la Chine. Ceci suggérerait que la Chine pourrait utiliser l'assistance financière comme un moyen subtile d'accéder aux ressources minérales de l'Afrique. Pour saisir les caractéristiques clés de cette relation, nous utilisons un cadre théorique impliquant deux pays : le donateur et le receveur. Dans le contexte de cet article, la Chine est le donateur et tout autre pays africain est le receveur. Les éléments essentiels de notre cadre d'analyse sont tels que le donateur libère son assistance économique à partir d'une formule qui lie ses préférences pour un produit particulier en Afrique au niveau de l'assistance à transférer. Ce cadre théorique montre que si la Chine augmente sa préférence pour les ressources naturelles des pays Africains, le niveau réel de l'assistance sera bien inférieur à sa valeur faciale, causant une réduction du revenu dans le pays receveur. Toutefois, une augmentation de la partie inconditionnelle de l'assistance permet d'augmenter le revenu du pays receveur.

Introduction

The growth trend experienced by the majority of African economies before the 2008-2009 financial crisis was mainly driven by domestic investments, increased productivity, and to a lesser degree, public consumption (IMF, 2007). The growth momentum was also

the result of marked improvement in the macroeconomic environment (World Bank, 2006). Indeed, inflation rates are at their lowest levels (with the exception of the recent food crisis), exchange rate misalignments have been virtually eliminated, and fiscal deficits have been significantly reduced. This new trend reflects a much more positive economic and political environment in Sub-Saharan Africa. The rise of the Chinese and Indian economies has fueled global demand for petroleum and other commodities (Davies, 2007). With improved governance and investment climate, Africa is indeed in a position to harness its natural resources and invest the proceeds to broaden its economic base for supporting economic growth and poverty reduction. Among its most development challenges, Africa faces a major infrastructure deficit, with investment needs estimated to be on the order of US$22 billion per annum and an associated financing gap on the order of US$10 billion per annum (Foster et al., 2008). Therefore, it is not surprising that trade relationship between China and Africa has been accompanied by a significant expansion of Chinese official economic assistance to the region, which is focused mainly on infrastructure and typically channeled through the China Ex-Im Bank (Foster et al., 2008); China has a major financier of infrastructure in the region. Concentrated in power and rail become, Chinese financing commitments in infrastructure increased from less than $1 billion per year in 2001-2003, to about $6 billion per year in 2006-2007. As pointed out by Davies (2007), Chinese policies, including trade and investments and its role as a donor and creditor, will have an important impact on the future of Africa and the joint global challenge to combat poverty.

The recent financial crisis has emphasized the significance of Sino-Africa cooperation with a significant deterioration of Africa's overall position during 2009 (Edinger and Sandrey, 2010); while Chinese imports from the world decreased by 11.3 percent overall, imports from Africa decreased by a much larger 24.3 percent, and while Chinese exports to the world declined by 15.9 percent, exports to Africa declined by a much smaller 6.2 percent. Therefore, there is a need to understand the main drivers behind China push to Africa in order to allow policymakers to devise cooperation strategies that are beneficial for all parties involved.

In this paper, we intend to analyze the key features of Sino-Africa cooperation using a theoretical framework involving two countries: a donor and a recipient. The donor is China in this context and the recipient is any African country. The key feature of the game is that the donor disbursed its economic support based on a formula in which it links its preferences for a particular good to the level of economic support to be transferred to the recipient.

Theoretical Framework

At the beginning of period 1, the donor makes a commitment to economically support the recipient. The economic support is disbursed at period 2. The donor's support is based on the following formula:

$$(1) \qquad S = \alpha - \beta \tau p$$

In equation (1), S is the economic support provided by the donor; α is the lump-sum amount of support which is fixed at the beginning of period 1; β is the donor weight or preference for the good produced by the recipient; τ is the proportion of goods the recipient is willing to transfer to the donor at time t=1; p is the international price of the good.

China's aid to Africa is motivated primarily for the need to secure access to raw materials and oil so crucial for the growing Chinese economy. Almost 70% of China infrastructure financing in Africa is concentrated in Angola, Nigeria, Ethiopia, Sudan, and Democratic Republic of Congo all of which have either oil fields or mining resources.

We assume that β and τ are positively related in such a way that if the donor's weight for the good increases, the donor will require a larger proportion of the good in which case the true value of support to be disbursed in t=2 is reduced by $-\beta\tau p$. The recipient decides how much of the good to transfer to the donor and the recipient is well aware of the formula used by the donor for the disbursement of the support. The two last assumptions assume that β is positive but small. In this model, the donor uses the economic support as a means to acquire goods that he would otherwise purchase.

For example, as shown in Table 1, countries such as Angola, Congo, and Sudan have major oil fields and pay for much of their assistance or loans from China with oil.

In our framework, the recipient country has a representative agent who lives two periods. It produces two goods each period. Good 1 is a primary good such as raw materials, oils, wood, ores, mines, etc. We assume that good 1 is the donor preferred good. Good 2 is any other type of goods produced by the recipient country, the *numeraire*, the production side of the recipient country has two revenues functions for both periods: and $R^2[p,1,\bar{L},\bar{K}+I]$ where $\bar{L}$ is the labor stock in both periods, $\bar{K}$ is the initial capital stock in period 1, and I is the investment in new capital which is added to the capital stock in period 2. The consumption side is represented by the inter-temporal expenditure function $E[p,1,\rho p,\rho,U^R]$ where U^R is the inter-temporal utility function of the recipient country, ρ is the recipient discount rate, and p is the vector of international prices for the first goods relative to the numeraire goods. These prices are exogenous since the recipient country is a small open economy. Equations (1) and (2) below describe the recipient's economy.

(2)

$$E[(1-\tau)p,1,\rho p,\rho,U^R]+I = R^1[(1-\tau)p,1,\bar{L},\bar{K}]+\rho R^2[p,1,\bar{L},\bar{K}+I] -\tau p(E_1-R_1)+\rho S$$

(3)

$$R_4^2[p,1,\bar{L},\bar{K}+I]=\frac{1}{\rho}$$

Equation (2) is the inter-temporal budget constraint of the recipient country where the left hand-side is the inter-temporal total expenditure and the right hand-side is the inter-temporal total revenue of the recipient country. The first term on the right hand-side represents the first period rental income and the second term is the discounted rental income for the second period. The two revenue functions are interpreted as the gross domestic product of the recipient economy for the two periods, and as such, they represent the production side

Table 1

Selected African countries with large reported aid and investments projects, 2002-2007

Country	Main exports to China	Pledged aid, loans, credit lines, and investments	Major types of financing (as reported)	Major types of projects financed (as reported)
Angola	Oil	$7.4 billion	Loans, interest-free loans, credit lines	Infrastructure (railways)
Congo (DRC)	Oil, minerals	$5 billion	Loans	Infrastructure, mining
Sudan	Oil	$4.2 billion	Investment, loans, grants	Oil refining; infrastructure, hydro power, humanitarian
Gabon	Oil, minerals	$3 billion	Investment, grants	Iron ore mining, infrastructure, port facilities, hydro power
Mozambique	Wood, ores	$2.4 billion	Debt cancellation, concessional loans, grants	Dam construction, infrastructure, national stadium
Equatorial Guinea	Oil	$2 billion	Concessional loans, credit lines	Not specified
Ethiopia	Oil drilling rights	$2 billion (includes 2008 aid of $150 million)	loans, grants, investment	Infrastructure, telecommunications, public buildings, hydropower, light industry
Nigeria	Oil	$1.6 billion	Debt cancellation, investment, grants	Offshore oil development, infrastructure (railways), medical training.

Source: NYU Wagner School, Understanding Chinese Foreign Aid:

A Look at China's Development Assistance to Africa, Southeast Asia, and Latin America, April 25, 2008.

of the economy[1] (Bhagwati 1998). The third term is the lost revenues that the recipient could have got if it did not transfer the goods to the donor, and the fourth term is the discounted amount of economic support. The first term on the left hand-side is the inter-temporal expenditure function and the second term is the expenditure on investment[2]. Equation (3) determines the optimal level of investment in the economy and is obtained by setting δUR/δI =0. The two equations and the foreign aid formula determine the three endogenous variables: U^R, I, and S. The policy instruments are β, α and τ given $p, \rho, \bar{L}, \text{ and } \bar{K}$.

In this model, we consider an active recipient deciding on how much of good 1 to transfer to the donor knowing the donor's preference. It follows that the recipient maximizes its national welfare with respect to the proportion of goods transferred. Equation (4) is the recipient country objective.

$$(4)\quad \underset{\tau}{Max} \quad W = U^R + \theta R_4^1 \bar{K} + \rho\theta R_4^2 (\bar{K} + I)$$

Equation (4) represents the national welfare where θ is a parameter capturing the weight that the social planner attaches to the stock of capital in period 1 and to the level of capital stock accumulated in period 2. Here, θ is greater than one; that is the social planner values the level of capital stock and its accumulation more than the utility of the country. Lahiri and Raimondos-Moller (2004) used a similar welfare function to represent the objective function of a social planner who receives political contribution. They interpreted the parameter θ as an indicator of corruption which captures political contributions, such as bribes, paid to ministers or government officials. Tejashree and Lahiri (2009) adopt the same type of welfare function with more weight given to the utility of rich population in a country. This type of welfare function was coined political support function by Van Long and Vousden (1991). Here, θ is exogenous and U^R is the utility function of the recipient country.

The first step in solving this model is to differentiate equations (3) and (4) with respect to the endogenous variables and policy instruments. We obtain:

$$(5)\quad (E_5 + \tau P E_{15}) dU^R = [\tau P^2 (E_{11} - R_{11}) \rho p \beta] d\tau + \rho d\alpha - \rho p \tau d\beta$$

$$(6)\quad R_{44}^2 \; d(\bar{K} + I) = 0$$

From equation (5), we can get the direct relationship between the policy instruments and the recipient utility by keeping constant other instruments.

$$\frac{\partial U^r}{\partial \tau} = \frac{\tau p^2 (E_{11} - R_{11}) - \rho\beta p}{E_5 + \tau p E_{15}} \Rightarrow \frac{\partial U^r}{\partial \tau} < 0$$

$E_{11} - R_{11}$ is the compensated price derivative of the excess demand for good 1 and is negative since the second direct partials derivative of expenditure function are non-positive.

$$\frac{\partial U^r}{\partial \alpha} = \frac{\rho}{E_5 + \tau p E_{15}} \Rightarrow \frac{\partial U^r}{\partial \alpha} > 0$$

$$\frac{\partial U^r}{\partial \beta} = \frac{-\rho \tau p}{E_5 + \tau p E_{15}} \Rightarrow \frac{\partial U^r}{\partial \beta} < 0$$

1. The two revenue functions are convex in price and concave in labor and capital. For more properties of the revenue function see Baghwati (1998) and Dixit and Norman (1980).

2. The expenditure function is convex in utility and concave in prices (Dixit and Norman, 1980).

The three partial derivatives above describe the relationship between the recipient utility and the policy instruments. The recipient utility is negatively related to both the donor's preference and the proportion of goods transferred; while, the utility is positively related to the lump-sum component of the economic support. Equation (5) determines the optimal level of utility of the recipient country. The first term on the right of equation (5) is the effect of a change of the proportion of goods transferred. The second, the third, and the fourth term are the direct effect of a change of the donor's policy instruments on the economic support.

Differentiating the welfare equation and plugging in equations (5) and (6), we get the following first order condition:

$$(7)\ W = 0 \Rightarrow -\tau P \varepsilon_m m - p\rho\beta \cdot + \theta \varepsilon_K^{\tau} R_1^1 E_5 (1+\tau C_Y) = 0 \Rightarrow f(\tau, \beta, \alpha, \theta) = 0$$

where $\varepsilon_m = -\frac{\partial m}{\partial P}.\frac{P}{m} = -\frac{\partial (E_1 - R_1^1)}{\partial P}.\frac{P}{m}$

$= -(E_{11} - R_{11}^1)\frac{P}{m}$

$m = E_1 - R_1^1$ we assume that $R_1^1 > E_1$

$\Rightarrow m < 0$

$\varepsilon_K = \frac{\delta R_1^1}{\delta \bar{K}}.\frac{\bar{K}}{R_1^1} = R_{14}^1.\frac{\bar{K}}{R_1^1}$

$c_Y = \frac{PE_{15}}{E_5}$

ε_m is the compensated elasticity of exports; m is the difference between the compensated demand and supply of good 1, it is called the compensated export demand function of good 1 and has the same properties as the expenditure function (Dixit and Norman 1980); R_{14}^1 is the second cross-partials between tariff rate and capital and ε_K is the elasticity of outputs, we assume R_{14}^1 to be positive; c_Y is the marginal propensity to consume; E_{15} is the second cross-partials between tariff rate and the recipient utility, Bhagwati (1998) shows that this cross-partial derivative is positive; E_5 is defined in as the inverse of the marginal utility of income, consequently, E_5 is low for the recipient country since the recipient country is poor and has a high marginal utility.

Equation (7) determines the optimal proportion of goods to be transferred for a given level of α and β where the first and second terms denote the marginal cost and the third term represents the marginal benefit. An increase in τ leaves the recipient country with fewer goods for consumption which leads to an increase in the marginal cost. At the same time, an increase of proportion of the goods transferred decreases the volume of economic support in period 2. This results to a decline of the recipient income, hence, increasing its marginal benefit.

To analyze the effect of a change of α, β, and θ on the proportion of goods transferred, we differentiate the first order condition (7) as follows:

$$(8)\ f_\tau d\tau + f_\beta d\beta + f_\alpha d\alpha + f_\theta d\theta = 0$$

where, $f_\tau = -p\varepsilon_m m + \tau p^2 \varepsilon_m (E_{11} - R_{11}) - \theta \varepsilon_K p[(1+\tau C_Y)(R_{11}^1 E_5 + R_1^1 E_{51}) - C_Y R_1^1 E_5]$

$$f_\beta = \frac{\rho \tau^2 p \varepsilon_m C_Y}{1+\tau C_Y} - p\rho\left[\frac{E_5 + \rho\tau^2\theta\varepsilon_K R_1^1 E_{55}}{E_5}\right]$$

$$f_\alpha = -\frac{\rho\tau\varepsilon_m C_Y}{1+\tau C_Y} + \frac{\rho\theta\varepsilon_K R_1^1 E_{55}}{E_5}$$

$$f_\theta = p\varepsilon_K R_1^1 (1+\tau C_Y) E_5$$

$f_\tau, f_\beta, f_\alpha$, and f_θ are obtained by taking the partial derivative of the first order condition with respect to τ, α, β, and θ. The second order condition (f_τ) is negative, hence, it satisfies the sufficient condition for the recipient's maximization problem. The sign of f_θ is unambiguously positive. The signs of f_β and f_α depend on the compensated elasticity of exports. If the compensated elasticity is high, the marginal cost of an increasing β increases. This makes f_β positive. Whereas a high compensated elasticity of exports decreases the marginal cost of an increasing α; hence, f_α is negative. From (8), we obtain the three comparative statics that characterize the cooperation between China and Africa:

$$\frac{d\tau}{d\beta} > 0, \quad \frac{d\tau}{d\alpha} < 0, \quad \frac{d\tau}{d\theta} > 0$$

It appears that both donors' policy instruments have different effect on the proportion of goods to be transferred. A change of β increases the proportion of goods to be transferred, in contrast, a change of α decreases the proportion of goods to be transferred. An increase of the recipient's weight on capital such as infrastructure investment raises the proportion of goods to be transferred. In other words, if China increases its preference for African's natural resources, the net volume of economic support is lower leading to an income reduction in the recipient country in the second period. To compensate for the loss of income, the recipient country is forced to increase the proportion of goods to be transferred to China. Unambiguously, an increase of economic support via an increase of China's lump-sum transfer raises the recipient income.

Nevertheless, we need to stress out that these results are highly sensitive to the price of good 1. If the donor's price is lower than the international price, the donor will benefit more from the transfer than the recipient. Indeed, the donor gain by acquiring goods at a lower cost than it would have purchased in the market. Here, the recipient is the loser since it could have been better off selling the goods at the higher international price and gain more revenues. By aggressively pursuing free trade agreements (FTAs) with African economic communities, China is guaranteed to obtain these goods at a lower price than the market price.

As described below, over the past 10 years, trade between China and Sub-Saharan Africa has been growing much faster than overall Chinese trade, primarily because of China's rising demands for natural resources, the expansion of the African market, and a decrease in trade restrictions (Fan et al., 2010).

Descriptive analysis

Primarily defined by political factors, the cooperation between African countries and China started since the 1950s. However, after a series of economic reforms undertaken in the 1980s, China's push to Africa has been motivated more and more by the search for new sources of energy and natural resources. In recent years, cooperation between China and Africa has significantly increased; trade between China and Africa reached a record US$106.84 billion in 2008, up 45.1 percent from 2007. The number of African countries with which China had more than US$1 billion in trade increased to 20 in 2008 from 14 in 2007.

As pointed by Lum, T. (2008), China has taken an aggressive stance toward establishing free trade agreements (FTAs) with trading partners including African countries. Indeed, China is negotiating a FTA with the Southern Africa Customs Union (SACU) which consists of South Africa , Botswana, Namibia, Lesotho and Swaziland . In March 2010, South Africa and China have signed trade contracts for products such as wine, frozen fish abalone and chrome oil worth R2.3 billion.

According to Lum et al. (2009), Chinese financial assistance and related economic cooperation are attractive to African countries for several reasons:

- Chinese financial assistance is often made available relatively quickly and easily — without the political, economic, social, and environmental conditions and safeguards and bureaucratic procedures that major OECD aid donors, multilateral financial institutions, and multinational corporations typically impose;
- China often promotes economic projects in countries, areas, and sectors that developed country governments and multinational corporations have avoided because they have determined them to be unfriendly, too arduous, or infeasible;
- Many Chinese funded or built public works such as national cultural centers, stadiums, and highways, are highly visible and provide tangible, short-term benefits.

Table 2 presents the main features of Chinese financial assistance compared to OECD countries. It is clear that Chinese provide their aid largely without the conditions that typically accompany Western aid—a good human rights performance, strong economic management, environmentally responsible policies and political openness on the part of recipient governments (Lancaster, 2007).

China has no clear criteria for how aid is calculated, or at least no public criteria (Davies, 2007). In addition, China's approach to development assistance is mostly bilateral. China does not seem to have specific country strategies.

Between 1995 and 2009, Chinese imports (Figure 1) from Africa were dominated by crude oil which represents 73.7 percent of total imports, followed far behind by iron (5.2 percent) and wood (3.3 percent). Unlike imports, Chinese exports are much diversified. The five top exports (see Figure 2) which include electric apparatus for line telephone (12.9 percent), woven

Table 2

Similarities and differences between OECD-defined "Official Development Assistance" (ODA) and "Chinese Aid"

	Government to government	Financing through development agency	Strong links to donor country economy	Concessional or favorable lending terms	Receives payment of debt in kind	Grant element of at least 25%	Private o corporate financing
OECD donors	Yes	Yes	No	Yes	No	Yes	No
China	Yes	No	Yes	Yes	Yes	No	No

Source: compiled from Davies (2007) and Foster et al. (2008).

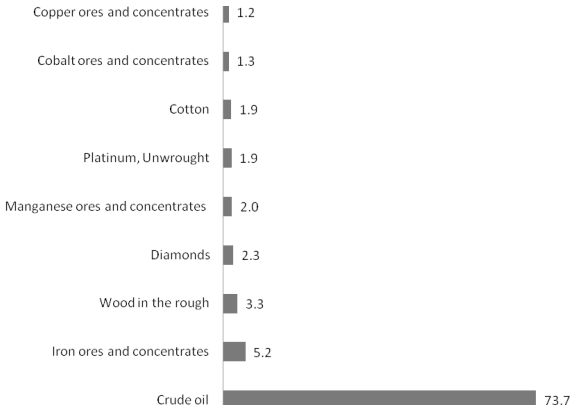


Figure 1.
Composition of Chinese imports from Africa between 1995 and 2009 (%)

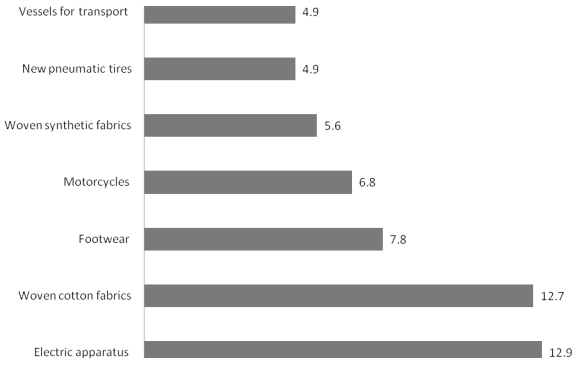


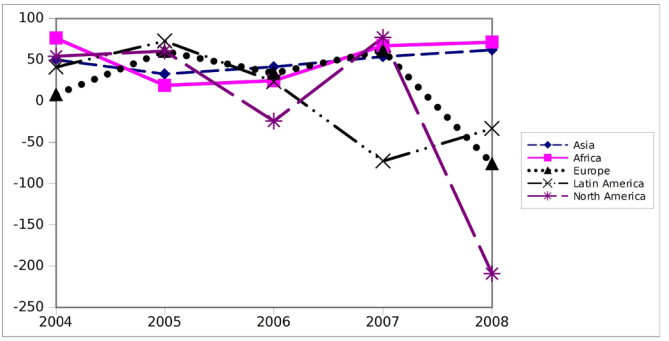
Figure 2.
Composition of Chinese exports to Africa between 1995 and 2009 (%)

cotton fabrics (12.7 percent), footwear (7.8 percent), Motorcycles (6.8 percent), and woven synthetic fabrics (5.6 percent), represent only 45.8 percent of total exports.

Although is still by far the privileged destination of Asia's Foreign direct investment (FDI) flows capturing 80.7 percent of total FDI flows in 2008, it is clear that Chinese investors' push to Africa has steadily increased from 74.8 million in 2003 to 5490.6 million in 2008. As shown in Figure 3, change in Chinese FDI flows towards Africa has been increasing: +19.0 percent, +24.7 percent, +67.0 percent, and +71.3 percent respectively in 2005, 2006, 2007, and 2008. The push to Africa seems to have been at the expenses of Europe, Latin America, and North America.

As mentioned before, china's financial flows to Africa in form of FDI and aids is positively linked to trade interaction between China. Available data suggest (see Figure 4) that countries with higher trade cooperation with China are more likely to receive higher FDI and aids flows.

Figure 3.
change in Chinese FDI flows across regions (%)



Source: Data from Chinese Ministry of Commerce (2008,2009). Statistical Bulletin of China's Outward Foreign Investment.

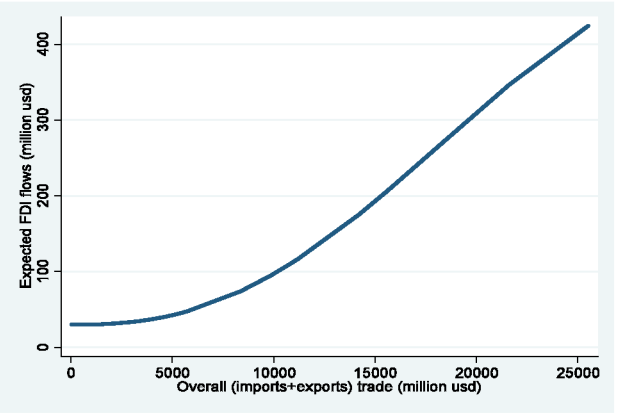


Figure 4.
FDI and trade between China and Africa (2003-2008)

Source: FDI from Chinese Ministry of Commerce (2009), and trade from http://www.tralac.org/cgi-bin/giga.cgi?cat=1044&limit=10&page=0&sort=D&cause_id=1694&cmd=cause_dir_news#china.

Between 2003 and 2008, as far as FDI flow is concerned, South Africa has attracted more investments from China than any other African countries. It just happens that South Africa is the second most African trade partern behind Angola which has the lead because of its oil exports. Sudan is also one of the biggest recipients of China' OFDI stocks to Africa, accounting for over 22 percent of the region's total stocks in 2006. As pointed out by Kiggundu (2008), state-controlled China National Petroleum Corp is the biggest foreign investor in the Sudan, confirming China's prime investment motivation for petroleum resources.

Nearly 70% of Chinese infrastructure financing on the continent is concentrated in Angola, Nigeria, Ethiopia, and

Sudan, all of which have oil fields (Foster et al., 2008). Sudan reportedly sends 60% of its crude oil to China (Hanson, 2008). Although this assistance is widely reported in the press, there are no official statistics on its overall value. Various attempts to estimate volumes have been speculative at best, but suggest a multi-billion-dollar scale (Foster et al., 2008). Lum et al.(2009) contend that Chinese foreign assistance is difficult to quantify because, still a developing country itself, China appears to administer foreign aid in an ad hoc fashion, without a centralized system, foreign aid agency and mission, or regularized funding schedule.

Brautigam (2007) reports that Chinese foreign aid to Africa totaled $1.4 billion for 2007, up from about $450 million a year a decade earlier, and that in the beginning of the present decade, 44% of that aid went to Africa. She notes that President Hu's 2006 Forum on China-Africa Cooperation (FOCAC) pledge to double the year 2006 level of assistance to Africa by 2009 would raise China's grant aid to Africa to the level of $1 billion per year. Indeed, the third ministerial summit on China-Africa cooperation held in 2006 approved a three-year action plan to forge a "new type of strategic partnership." The plan pledges that China will:

- Double aid to Africa by 2009 (to about $1 bn)
- Set up a $5 bn China-Africa development fund to encourage Chinese companies to invest in Africa
- Provide $3 bn in preferential loans and $2 bn in preferential buyer's credits to African countries
- Cancel all debt stemming from Chinese interest-free government loans that matured by the end of 2005, for the 31 highly indebted and least developed countries (LDCs) in Africa that have relations with China (an amount estimated at around $1.4 bn)
- Further open China's markets to exports from African LDCs by increasing from 190 to 440 the number of products receiving zero-tariff treatment
- Train 15,000 African professionals, double the number of Chinese government scholarships given annually to Africans (to 4,000) and send 100 senior agricultural experts and 300 youth volunteers
- Build 30 hospitals, 30 malaria treatment centres and 100 rural schools.

Conclusion

For the past ten years, China's push to Africa has been characterized by an exponential increase in trade from $3 billion in 2000 to almost $80 billion in 2008. Available data suggest that the current trend in China-Africa cooperation is primarily driven by China's appetite for minerals; countries endowed with crude oil and mining are more likely to receive higher FDI and financial assistance. Our theoretical framework shows that if China increases its preference for African's natural resources, the real volume of economic support is lower than it actually appears leading to an income reduction in the recipient country in the second period. However, an increase in the economic support via an increase of China's unconditional transfer raises the recipient income. It is unlikely that the Chinese will participate any time soon

in the aid pooling mechanisms; therefore, African countries will need to devise strategies that enhance the benefits of trade and investment while minimizing any potential lost. ¶

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