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EXPORTS CONCENTRATION AND RESILIENCE TO ADVERSE SHOCKS: EMPIRICAL EVIDENCE FROM AFRICA

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Abstract

This paper is concerned with the degree of geographic concentration of African exports and the potential impact of this concentration on the resilience of African economies to adverse economic and financial shocks. In order to assess the degree of geographic diversification of export, a gravity equation is estimated by applying a Poisson Pseudo Maximum Likelihood (PPML) method with country-pair fixed effects. The study uses a panel of 15 African countries over a period from 2000 to 2013 with major global trading partners. Main findings suggest that the higher the degree of export concentration by destination, the higher the negative impact on exports of African countries. However, during the global and financial crisis, this negative impact is insignificant because the nature of products exported by the continent which are primarily energy and agriculture commodities. Moreover, the emergence of China as a partner allowed a greater resilience to the crisis and drove global demand for commodities.

Keywords: African Trade Diversification; Global Financial Crisis; Gravity Model; PPML Estimation

INTRODUCTION

Since 2000, the African continent has recorded steady economic growth with an average real GDP growth rate of more than 5%. This performance has been mainly driven by factors including better macroeconomic management, improved political stability, and institutional reforms undertaken by African countries (Mckay, 2013; McMillan and Harttgen, 2014; Timmer et al., 2012; Young, 2012). Exports of primary commodities have also been a major contributor to the continent's economic performance (Delgado, 1995; Bruckner and Lederman; 2012; World

Bank, 2012). In fact, higher global commodity prices and increased demand for African commodities mainly from China have lifted the continent's exports of commodities which resulted in higher GDP growth rates (Brenton and Walkenhorst, 2010; Balliamoune-Lutz, 2011; Diaw and Lessoua, 2013). During the global financial crisis, Africa's international trade proved to be relatively resilient to the collapse of international trade volumes that resulted from two factors, namely falling global demand and tightening financing conditions. Between 2005 and 2014, total African trade grew by an average rate of 9% outperforming GDP growth of the region, at around 5% as well as world trade, at about 6%.

However, the current counter shock affecting global commodity markets that started in mid-2014, has led to significant pressure on prices of major commodities with export interest to Africa. These commodities include, among others, oil, iron ore, copper, cotton, cocoa and coffee. Many African countries have been affected by this counter shock as attested by the escalation of macroeconomic management imbalances, deterioration of terms of trade, scarcity of foreign reserves and depreciation of local currencies (International Monetary Fund, 2015). In addition to commodity markets volatility, the slowdown of the Chinese economy, which has emerged to become the continent's largest individual trade partner, has added to the continent's economic woes through weakening of trade linkages that has translated into deterioration of trade balances. Furthermore, the sluggish economic recovery of the Eurozone, the continent's largest trading region, has weighed on Africa's trade. These factors combined substantially contributed to the year-on-year decline of African trade by about 16% in the first half of 2015, a trend that is set to persist in the medium term if fundamentals of commodity markets and the global economy remain unchanged in the near future.

Amurgo-Pacheco and Pierola (2008) provide a geographic definition with export diversification related to three factors: (i) export of new products to existing markets, (ii) export of old products to new markets, and (iii) export of new products to new markets. In the case of Africa, trade is concentrated both geographically with few trading partners and at the level of product/industry mainly in commodities and raw materials. Particularly, due to the colonial past and common language factors, most African countries maintained strong trade relationships with Europe and the US which have been the main trading partners of the continent over the past few decades. More recently, China has emerged as a key trade partner of Africa. For instance, total trade between China and Africa rose from USD7.3 billion in 2000 to USD159 billion in 2014 accounting for 13% of the continent's total trade and making China the continent's largest individual trade partner. This geographic concentration has weighed on African trade following China growth deceleration and sluggish economic recovery in advanced economies.

In terms of product/industry concentration, commodities remain the main source of export revenues for many African countries as the continent's economy is still highly dependent on commodities sector. For instance, African oil-exporting countries account for about half the continent's GDP and about 55% of its total trade. Revenues from commodities exports represent about 80% of total export revenues of Nigeria, Africa's largest economy and more than 95% for Angola and Equatorial Guinea.

This paper is concerned with the effect of geographic concentration of African exports on the continent's resilience to the global economic and financial crisis of 2008/09. Using a panel of 15 African countries over the period 2000 to 2014, the model estimates the extent to which concentration of African trade with few advanced and emerging economies affected their degree of resilience to the crisis and the level of their bilateral trade. Following the literature, the Poisson pseudo Maximum likelihood method is used to estimate the coefficients of the gravity equation (Silva and Tenreyro, 2006).

The rest of the paper is organized as follows. The next section presents a literature review. Section 3 considers some stylized facts about the dataset, the variables and the degree of geographic concentration of African exports. Section 4 describes the empirical methodology adopted. Section 5 discusses the empirical results of the study and section 6 concludes the paper.

LITERATURE REVIEW

The degree of diversification of trade and its level matter for economic growth and development (Ben-David, 1996; Cadot et al., 2011; Cieslik et al., 2012; Herzer, and Felicitas, 2006; Rondeau and Roudaut, 2015). It is well documented in the literature that export diversification can be positively associated with GDP growth. In fact, export diversification reduces income volatility by lowering the level of exposure to a particular set of products or services exported by the country or to a few trading partners. Thus, diversification of trade partners or of the trade basket reduces vulnerability to severe shocks related to deteriorating terms of trade (Lederman and Maloney, 2012; Lederman and Klinger, 2006). Lederman and Maloney (2012) find that export concentration has negative implications for future economic growth. This is confirmed by Hesse (2009) who demonstrates that concentration of exports lowers per capita GDP in developing countries. In this context, export diversification plays an important role in the process of structural transformation of a country which ultimately will lead to higher GDP and GDP per capita.

The relationship between export diversification, productivity and employment has also been analyzed in an empirical setting without reaching decisive conclusions as with growth.

Juvenal and Monteiro (2013), in a study covering Argentinian firms, find that exporting to several countries lowers uncertainty of demand that firms face, thereby raising incentives for them to increase their investment capacities aimed at scaling up productivity. For trade diversification impact on employment, Naude and Rossouw (2011) show that export diversification has a positive impact on employment in South Africa. However, their general equilibrium model fails to detect the same positive relationship in the case of Brazil, China and India. Another stream of the empirical literature focuses on the degree of geographic diversification of exports and performance of large corporates and small and medium-sized enterprises (SMEs). For example, Beleska-Spasova and Glaister (2010) find, for a large sample of British exporting companies, a significant relationship between geographic diversification and export performance.

Some papers attempted to examine the link between export diversification and the global financial crisis. Costa Neto and Romeu (2011) considered the role of export diversification in determining the outcomes of trade during the global financial crisis. Applying an adapted gravity trade model empirically tested on a database containing over 500 thousand observations for Latin America, they find that increasing the diversity of both export sectors and export products within sectors by one standard deviation reduces the quarterly decline in exports by about 4.7%. However, diversifying exports across many different trade partners does not significantly affect trade outcomes.

In another paper looking at the structural changes in the composition of trade due to economic crises, Bagci (2009) find that economic and financial crises could have a delayed and positive impact on trade diversification. It is revealed that significant diversification happens two, three and five years following economic crises and only one year after a financial crisis. Kooi (2009) shows how different the global financial crisis affected Mexico and Brazil through their trade orientation and trade composition. In fact, trade diversification helped Brazil weather the effects of the crisis while Mexico, a country for which the US is the destination of 80% of its total exports, experienced severe contractions of its trade.

EMPIRICAL STUDY

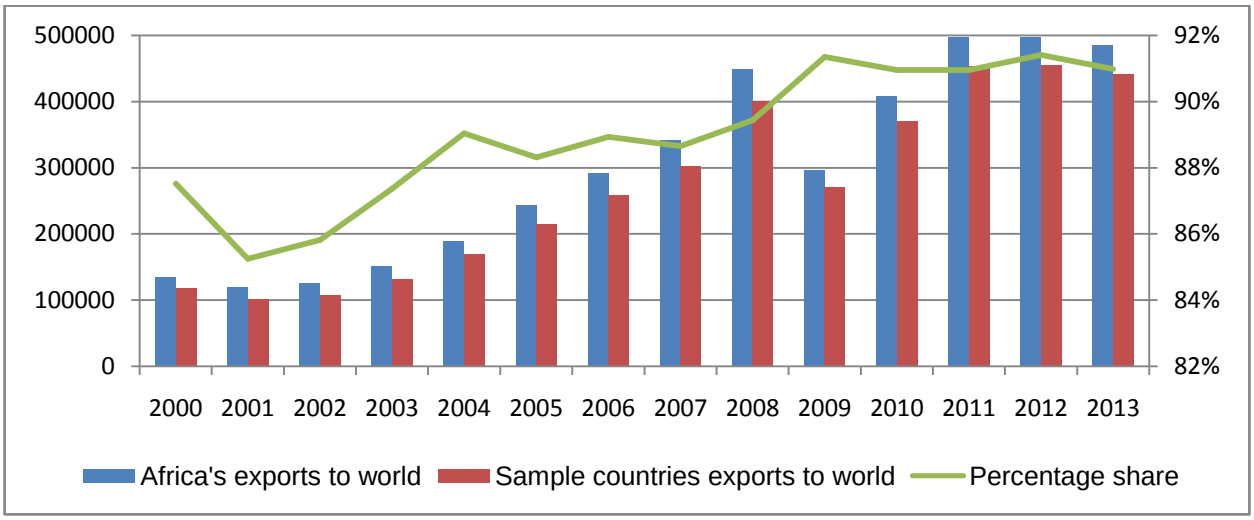
Stylized Facts

The objective of this section is to provide some stylized facts about African exports, to show the extent to which the continent's exports are concentrated geographically within few partners, namely, USA, UK, France, Germany, Italy, Spain and China.

In Figure 1, we compare exports of Africa as a whole with the sample of 15 African countries selected for the analysis (Algeria, Angola, Cameroon, Côte d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Morocco, Mozambique, Nigeria, South Africa, Tanzania, Tunisia and Zambia.).

Total exports of the 15 selected African countries accounted for 91% of the continent's total exports in 2013 up from 88% recorded in 2000. The value of these exports reached 440 billion US$ in 2013 compared with 485 billion US$ for the continent.

Figure 1: Africa's exports to the world vs. sample African countries exports to the world, in US$ million (2000-2013)



Source: Author calculations using IMF-DOTS data

Table 1 shows the relative importance of each of the seven trading partners with the selected African countries in 2013. Most of the African countries have one or two trade partners whose share in the total exports exceeds 10%. Two countries, namely Angola and Tunisia had more than 65% of their merchandise goods exported to the seven trade partners with a significant concentration of exports to two countries, USA and China for Angola (58% of the total) and France and Italy for Tunisia (47% of the total).

Table 1: Share of African countries trade with selected partners in 2013

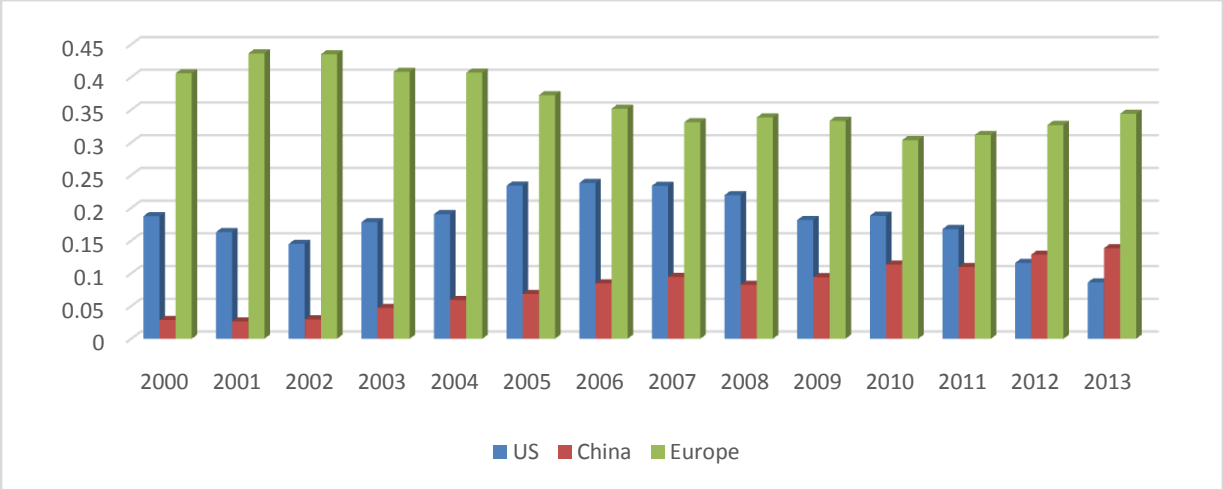
	USA	UK	France	Germany	Italy	Spain	China	Total
Africa	**8.4%**	**4.4%**	**5.9%**	**3.0%**	**4.3%**	**6.1%**	**13.5%**	**45.5%**
Algeria	8.1%	10.9%	10.3%	0.0%	13.7%	15.7%	3.3%	61.9%
Angola	12.5%	1.4%	1.7%	0.9%	1.0%	4.1%	45.5%	67.2%
Cameroon	2.9%	1.8%	4.8%	1.4%	0.0%	12.8%	5.8%	29.5%
Côte d'Ivoire	6.8%	1.8%	6.2%	5.8%	1.7%	1.7%	1.1%	25.1%
Egypt	4.2%	3.4%	3.2%	2.2%	9.3%	2.2%	2.0%	26.4%
Ethiopia	7.9%	1.5%	1.8%	8.2%	2.8%	0.4%	12.9%	35.4%
Ghana	3.9%	4.2%	11.7%	4.5%	9.1%	2.2%	8.0%	43.6%

Table 1...

Kenya	6.1%	7.7%	1.1%	1.7%	0.9%	0.4%	0.9%	18.9%
Morocco	4.2%	2.7%	21.5%	2.7%	3.8%	18.9%	1.6%	55.3%
Mozambique	1.6%	2.9%	1.2%	0.9%	9.9%	6.1%	9.5%	32.1%
Nigeria	11.1%	4.7%	4.8%	5.1%	2.5%	7.2%	1.5%	36.8%
South Africa	7.3%	3.4%	1.0%	4.5%	1.1%	0.9%	12.5%	30.8%
Tanzania	1.7%	0.9%	1.0%	4.0%	1.5%	0.6%	13.2%	22.9%
Tunisia	2.4%	3.9%	27.5%	9.4%	19.3%	4.9%	0.3%	67.7%
Zambia	0.1%	1.4%	0.0%	0.2%	0.0%	0.0%	21.3%	23.0%

Source: Author calculations using IMF-DOTS data

Figure 2: Main partners' exports share



Source: Author calculations using IMF-DOTS data

Figure 2 explains that the share of exports to china has increased relatively to other partners. It has risen from 2% in 2000 to 13% in 2013. Thus, its share has exceeded the US one (8%), whereas, the European share has decreased from 40% to 34%.

Methodology

The earliest work explaining and estimating the trade flows between two countries was initiated by Jan Tinbergen (1962) through the gravity model analogous to Newton's law of universal gravitation. This model in its simplest form suggests the existence of a positive relationship between the trade flows from country i to country j at the year t, (T_{ijt}), and the product of the two countries' GDPs, (Y_{it}) and (Y_{jt}), and a negative one between (T_{ijt}) and (D_{ij}), the distance between these two countries, which represents all trade costs. More generally, the model can be written: $X_{ijt} = \alpha_0 Y_{it}^{\alpha_1} Y_{jt}^{\alpha_2} D_{ijt}^{\alpha_3}$. Where $\alpha_0, \alpha_1, \alpha_2 and \alpha_3$ are unknown parameters.

In its stochastic form, the gravity equation is written as:

$X_{ijt} = \alpha_0 Y_{it}^{\alpha_1} Y_{jt}^{\alpha_2} D_{ijt}^{\alpha_3} \mu_{ijt}$. Where μ_{ijt} is assumed to be independent of the regressors and $E(\mu_{ijt} \backslash Y_{it}, Y_{jt}, D_{ijt}) = 1$ leading to: $E(X_{ij} \backslash Y_i, Y_j, D_{ij}) = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} D_{ij}^{\alpha_3}$.

Since the gravity model is identified in the multiplicative form, it is not possible to employ standard estimation techniques. So, the solution used in the trade literature is to estimate the logarithmic transformed model:

$\ln X_{ijt} = \ln \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 lnY_{jt} + \alpha_3 lnD_{ijt} + ln\mu_{ijt}$.

Afterwards, Anderson and Wincoop (2003) argue that the traditional gravity equation is not correctly specified since it doesn't take into account multilateral resistance terms. Consequently, the new version of the gravity model is written as:

$X_{ijt} = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} D_{ij}^{\alpha_3} e^{\theta_i + \theta_j}$.

The model assumes the unit-income elasticity with $\alpha_1 = \alpha_2 = 1$ and it is:

$X_{ij} = \alpha_0 Y_i \ Y_j \ D_{ij}^{\alpha_3} e^{\theta_i d_i + \theta_j d_j}$ and its stochastic form is:

$E(X_{ij} \backslash Y_i, Y_j, D_{ij}, d_i, d_j) = \alpha_0 Y_i \ Y_j \ D_{ij}^{\alpha_3} e^{\theta_i d_i + \theta_j d_j}$ because $E(\mu_{ij} \backslash Y_i, Y_j, D_{ij}, d_i, d_j) = 1$.

The log-linearization of the multiplicative form of the model is:

$\ln X_{ijt} = \ln \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 lnY_{jt} + \alpha_3 lnD_{ijt} + \theta_i + \theta_j + ln\mu_{ijt}$.

And the expected value of the equation will be:

E($\ln X_{ijt}$) = $E(\ln \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 lnY_{jt} + \alpha_3 lnD_{ijt} + \theta_i + \theta_j + ln\mu_{ijt})$.

= $E(\ln \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 lnY_{jt} + \alpha_3 lnD_{ijt} + \theta_i + \theta_j) + E(ln\mu_{ijt})$.

To apply the OLS estimation technique and obtain consistent estimators, hypothesis that $E(ln\mu_{ijt} \backslash Y_i, Y_j, D_{ij})$ is zero or a constant must be assumed. However, using Jensen's inequality lnE(μ_{ijt}) # E(ln(μ_{ijt}) and in presence of heteroskedasticity of the random variable, this assumption is not possible.

Silva and Teneyro (2003) show that this situation leads to inconsistent OLS estimator. To solve this problem, they propose to estimate the model in levels, instead of taking logarithms, and suggest two alternative methods: the Non-Linear Square (NLS) and the Poisson Pseudo Maximum Likelihood (PPML). But, as the NLS gives more weight to noisier observations, the second method is preferred.

When the simplified form of the gravity equation expressed by the dependent variable y_{ijt} and independent variables x_{ijt} which include proxies for fixed effects and the β parameters is considered, the estimation of the coefficients of interest is a solution to the maximization of the log-likelihood function:$L_{ij}(\beta) = \sum_{t=1}^{T} (y_{ij} \ln(m(x_{ijt}, \beta)) - m(x_{ijt}, \beta))$.

Econometric Estimation

Through the theoretical method explained in the previous section, an export function is estimated using a panel data of 1460 observations for the period 2000-2013. The equation analyzes the one way-trade flowX_{ij} from an African country i to his partner j in the year t:

$$\mathbf{X_{ijt} = \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 \ln Y_{jt} + \alpha_3 \ln D_{ij} + \alpha_4 Herfindal_{it} + \alpha_5 crisis + \alpha_6 herfcrisis_{it} + \alpha_7 language_{ij} + \alpha_8 colon_{ij} + \alpha_9 lnreexchange_{ijt} + \alpha_{10} oilp_i + \theta_{ij} + \theta_t + \varepsilon_{ijt}.}$$

Where: $\mathrm{Y_{it}}$ and $\mathrm{Y_{jt}}$ represent respectively the GDP of the African exporting country and its partner in the year t. Applying the unit-constant gravity equation, the estimated effects of these variables would be equal to 1. D_{ij} is the distance between the country-pair trade partner and the estimated parameter for this variable is presumed to be negative. $Herfindal_{it}$ represents the Herfindal index which measures the trade partner concentration and calculated by $H = \sum_{k=1}^{n} s_k^2$ where s_k is the share of the country j with respect to the group. The index varies between 0 (highly diversified) and 1 (highly concentrated). Therefore, the estimated coefficient is assumed to be negative if the degree of diversification grows.

To control the effect of the financial crisis, the dummy variable$crisis$ is introduced. This variable is equal to 1 in the crisis period (2008-2009) and zero otherwise. A negative sign of this coefficient is expected.

$herfcrisis_{it}$ the country's trade concentration with a partner interacted with the crisis dummy. The estimated coefficient is would be negative because the positive coefficient would indicate that concentrated exports helped to attenuate the crisis effects.

A common language between the trade partners should make international trade transactions easier to undertake. For this reason, the estimated effect of the variable $\mathrm{language_{ij}}$ would be positive.

The dummy variable$\mathrm{colon_{ij}}$ explains the colonial links between the exporter country and his partner. A positive influence of this relationship is anticipated, because it reduces cultural and customs differences between the trade partners.

The real exchange rate for the national currency per one unit of the trade partner currency referred to the variable $lnreexchange_{ijt}$ permits to control the macroeconomic effects.

The dummy variable $oilp_i$ is equal to 1 for the African oil-exporting countries and zero otherwise. The estimated effect of this variable is likely to be positive.

A country-pair fixed effects $(\theta_{ij})$and time dummies $(\mathrm{\theta_t})$are introduced to control geographical export diversification and time effects (Shepherd, 2010; Didier, 2017).

The panel PPML methodology is used. Then, Hausman test is implemented to choose between the fixed effects and the random effects models. Under the null hypothesis, the second

estimator is assumed to be consistent and efficient. The result of the test permits to reject this hypothesis, so the fixed effect estimation is chosen.

Table 2: Variables Description and Sources

Variable	Description	Source
Bilateral Exports	Exports of the fifteen African countries to the seven partners (in US$ millions)	International Monetary Fund's Direction of Trade Statistics Database (2015)
GDP	GDP in current dollars (in US$ millions)	World Bank's World Development Indicators Database
Nominal Exchange Rate	Rate for the national currency per one unit of the trade partner unit	International Monetary Fund's International Financial Statistics Database (2015)
CPI	Consumer price index	International Monetary Fund's International Financial Statistics Database (2015)
Real Exchange Rate	Derived from Nominal Exchange Rate and CPI	-
Gravity variables	Distance (in KM), Colony (Dummy variable with value 1 if the trading partners had a colonial past with the African country) and Language (Dummy with value 1 if the African country has the same official language as the trading partner)	Cepii Database on Gravity
Herfindahl Index	Measuring the trade concentration. It varies between 1 (highly diversified) and 0 (highly concentrated)	Calculated using the formula in section 4.2: Empirical Analysis of Trade
Effect Financial Crisis	Dummy variable with value 1 during crisis period (2008 and 2009), 0 otherwise	-
Effect Herfindahl index -Financial Crisis	Measuring the interaction between degree of concentration (Herfindahl index) and effect of the financial crisis	-
Status of country as oil producer	Dummy variable with value 1 if the country is net oil-producer, 0 otherwise	International Monetary Fund's Classification of Oil-Exporting vs. Oil-Importing countries. Available in World Economic Outlook Database

ESTIMATION RESULTS

Table 3: Empirical Results – Fixed vs. Random Effect Models

VARIABLES	(1) Fixed Effect	(2) Random Effect
Lgdpexp	0.515***	0.153**
	(0.00196)	(0.00611)
Lgdpimp	0.534***	-0.462
	(0.00323)	(0.0474)
Ldist	-0.518***	-0. 0373
	(0.00316)	(0.0369)
Herfindahl	-0.112***	-0.0682***
	(0.0234)	(0.0248)
crisis1	0.00837	0.00462
	(-0.0159)	(-0.00843)
herfcrisis1	-0.0675	-0.0426
	(0.0604)	(0.0322)
Lchange	0.0186*	-0.0270***
	(0.000957)	(0.00916)
Oilp	0. 499***	0.180***
	(0.00733)	(0.0457)
Language	0.0178***	-0.0769***
	(0.00593)	(0.0183)
Colon	0.0339***	-0.00165
	(0.0072)	(0.00451)
Constant	1.210***	2.786***
	(0.0889)	(0.549)
Observations	1,460	1,460
R-squared	0.623	0.893
Hausman test	16.253	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The coefficient of the Herfindahl index is statistically significant at 1% level and negative, which is in line with the assumption that the degree of export concentration determines trade outcomes. That is, a one percentage point increase in the level of trade concentration leads to 0.1 percentage point contraction of the level of bilateral trade. This implies that higher degree of trade concentration within few partners has negative consequences on bilateral trade. This result conflicts with Costa Neto and Romeu (2011) who find that more diversified destination of exports may decrease total export growth. Their findings suggest that concentrating exports on fewer trading partners is beneficial especially in times of crisis.

The coefficients for both variables capturing the effect of the financial crisis and the interaction between degree of concentration and financial crisis, respectively, crisis1 and herfcrisis1, are both statistically not significant. This finding seems unexpected as the trading partners, especially USA and European countries have been severely affected by crisis and their trade with the world had collapsed over the two to three years following the onset of the crisis. This result could however be explained by the structure of African exports. In addition to the concentration by geographic destination, African exports are also concentrated in terms of products. The African continent mainly exports commodities including agricultural commodities such as cocoa and coffee, metals and minerals, and energy commodities such as oil, gas and coal. The financial crisis, and despite faltering global demand, was accompanied by a commodity super-cycle that boosted export revenues of African countries. In addition, China, which emerged in the past decade to be among the major trading partners of Africa, showed greater resilience to the crisis and drove global demand for commodities, especially from Africa.
Most of the other control variables used in the model are statistically significant with the expected sign. This result is in line with the related theoretical and empirical literature on the determinants of international trade. Indeed, the estimated effects of the language, colony, and oil production are positive. Distance, however, has a negative sign confirming early findings of gravity models that longer distances between two countries reduce bilateral trade between them, mainly due to factors cost.

CONCLUSION

Using a panel data methodology, this paper offers an empirical analysis of the degree of export concentration by destination of selected African countries and its impact on exports of those countries with major trade partners of the continent. The paper shows that the higher the degree of concentration of African trade with few trading partners, the higher the negative impact on the level of that trade. But this situation did not affect African exports during the global crisis. This result can be explained by the fact that on the one hand, the large share of products exported is

composed by energy and agriculture commodities. On the other hand, international demand of these products especially oil, was boosted by the Chinese demand. In recent years, the debate on the necessity for African countries to further diversify their economies away from primary commodities and to promote structural diversification has emerged. Hence, a more detailed analysis on the ability of African countries to develop promoting sectors with high productivity and added value is necessary. This investigation could use also the microeconomic level to measure the performance of enterprises and their contribution to the geographic and product diversification.

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