

EXTRACTIVE RESOURCES, GLOBAL VOLATILITY AND AFRICA'S GROWTH PROSPECTS¹

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ABSTRACT

Africa is endowed with an incredible amount of natural resources of which the extractive sector is a key component. Unfortunately, however, the continent is characterized by a paradox of plenty or resource curse, depicting a situation of abundant resources that have not translated into economic growth and prosperity for the population. The potential role of the extractive sector is further affected by global volatilities. This article reviews the importance of the extractive sector to selected African countries. It identifies sources of global volatility that affect the sector and further attempts to establish the factors that drive the volatility-growth nexus. We use panel data covering 18 selected African countries from 1970-2013 to explain the gross domestic product (GDP) growth. Volatility persistence estimates are also calculated. The article further examines the policy space that African governments might consider to make the extractive sector play a major role in the development of the continent. We find that the extractive sector makes a huge contribution to GDP of the selected countries. The empirical evidence also indicates that 12 out of 18 countries find it difficult to adjust their economies back to equilibrium when hit with volatility shocks or changes in the volatility of GDP growth.

Keywords: economic diversification, extractive sector, growth, natural resources, resource curse, volatility

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1 The views expressed in this chapter are those of the authors and should not be attributed to their affiliated institutions.

1. INTRODUCTION

The World Trade Report² defines extractive resources as a class of natural resources. Specifically, they are “stocks of materials that exist in the natural environment that are both scarce and economically useful in production and consumption either in their raw state or after a minimal amount of processing”. Extractive resources are exhaustible or non-renewable, implying that only fixed quantities are available resulting in increasing costs associated with depletion. They are also characterized by about four things: uneven distribution across countries – resource endowment varies considerably within countries and across countries; externalities associated with their exploration; dominance in national economies; and susceptibility to volatility. While some countries (Congo, Angola, Algeria, Gabon, Equatorial Guinea, Zimbabwe, Tunisia, Mali, Libya, Egypt, Côte d’Ivoire, South Africa, Mozambique, Sudan, Democratic Republic of Congo (DRC) and Ghana) are blessed abundantly with extractive resources such as gold, oil, copper, bauxite, natural gas and other precious metals, other countries (Togo, Benin, Morocco, Burkina Faso, Mali, among others) only have a little or absolutely nothing to boast of. Exploration and extraction of such resources often damage the environment, pollute the water bodies, distort the natural habitats of bio-diversity and can ultimately result in climate change. Also, due to the volatile nature of prices, their markets are inherently unstable, which affects the growth in economies that are dependent on these commodities.

Historically, commodity prices have been highly volatile and unpredictable such that prices can increase by as much as from 40 to 80 percent.³ This has created enormous challenges for resource-rich countries. Among these challenges are the highly volatile incomes⁴ for the affected countries thereby distorting their fiscal balances.

2 World Trade Report. Trade in Natural Resources, World Trade Organization (2010) <https://www.wto.org/english/res_e/booksp_e/anrep_e/world_trade_report10_e.pdf> accessed 6 February 2016.

3 International Monetary Fund, How to Manage the Commodity Call Coaster by Vito Gasper (2015) <www.blog-imfdirect.imf.org/2015/10/07/how-to-manage-the-commodity-roller-coaster> accessed 6 February 2016.

4 Frankel, J., The Natural Resource Curse: A Survey of Diagnoses and Some Prescriptions, in Arezki, Mr Rabah, Ms Catherine A. Pattillo, Mr Marc Quintyn, and Min Zhu. *Commodity price volatility and inclusive growth in low-income countries*. International Monetary Fund, 2012.

Furthermore, government expenditures in such countries are unstable as they rise in times of commodity booms and fall with the commodity prices fall, exacerbating economic volatility. These countries must therefore deal with the long-run downward trend of the terms of trade between commodities and manufactures⁵ and the inability of commodity-exporting countries (CEC) to sustain growth trajectories based on commodities. This is evident in the persistent fall in the primary balance of 2015 for most resource exporting countries, which saw about 5 percentage points fall in GDP on the average.⁶ African countries such as Angola, Algeria, Egypt, Nigeria, Zambia, Gabon, Cameroon and Botswana were unable to escape the deterioration in the 2015 primary balance. Also, the recent experience with the world price of oil exemplifies how volatile revenues from oil and gas can become when prices fall tremendously.

There is a widespread perception that resource-rich countries have an easy path to economic development. Reality is, however, different as empirical evidence shows that countries with abundant resources do not really depict high economic development. The phenomenon is so common in these countries and is now known as the resource curse.⁷ The natural resource curse or the paradox of plenty is a phenomenon that development practitioners have been dealing with over the past three decades. The high volatility of extractive resource revenues and other global volatility that most nations face in combination with other institutional and structural shortcomings pose numerous challenges in translating these resources to sustainable and inclusive growth. It is important to note that resource revenues become highly volatile mainly because developed nations drive the global demand for extractive resources.⁸ It is now evident that CEC needs to design strategies that allow them to manage their resources in a sustainable and transparent manner to ensure that the growth prospects are improved.

5 UNCTAD: Excessive Commodity Price Volatility: Macroeconomic Effects on Growth and Policy Options. Contribution from the UNCTAD Secretariat to the G20 Commodity Markets Working Group. United Nations publication, New York and Geneva (2012).

6 IMF4 (n 4).

7 Ibid.

8 Bardouille, P, A. Hamblin & H. Pley. "Mining: Unearthing Africa's Potential in Africa's Potential:" Mckinsey on Africa: A continent on the Move, McKinsey Global Institute, New York (2010).

No attempt is made in this article to do an extensive review of the literature on this subject. However, it is important to observe that numerous attempts have been made to gain an insight into how volatility of natural resources revenues might affect growth.⁹ Cashin et al (2002)¹⁰ show that real commodity prices affect real exchange volatility. Van der Ploeg and Poelhekke (2009)¹¹ find evidence suggesting that “the resource curse is foremost a problem of volatility”. Arezki and Nabli (2012)¹² also undertook a stock-taking exercise of economic performance of Middle East and North Africa (MENA) countries over forty years. The authors find that resource-rich countries in the region experienced relatively low and non-inclusive economic growth and high macroeconomic volatility.

This article aims to achieve two objectives. First, it reviews and summarizes the importance of extractive resources to national economies for a selected number of African countries. Second, it explores the relationship that exists between volatility and economic growth. With this in mind, section 2 examines the contribution of the extractive sector to the national economies of selected African countries, using the Gross Domestic Product (GDP) as the metric. Section 3 reviews the sources of global volatility drawing specific attention to how volatility might hamper growth. The work in these two sections draws on a survey of the literature and published data in the public domain. In section 4, we provide evidence on the volatility-growth nexus by estimating volatility persistence in the sample countries adapting a panel data approach. The parameter aims to provide evidence on whether the selected countries studied are able to adjust their economies back to equilibrium when hit with volatility shocks. How to make the best of the extractive sector is the subject section 5. The section reviews, based on the literature, policy options that could enhance the contribution of the sector to inclusive growth. We make concluding remarks in the final section.

9 Aghion, Philip, Phillippe. Bacchetta, Romain Rancière and Kenneth. Rogoff. 2006. Exchange Rate Volatility and Productivity Growth: Throle of Financial Development, *Discussion Paper No. 5629*, CEPR, London (2006).

10 Cashin, Paul, and C. John McDermott. “The Long-Run Behavior of Commodity Prices: Small Trends and Big Variability.” *IMF Staff Papers* 49, No. 2 (2002), 175-199.

11 Van der Ploeg, Frederick, and Steven Poelhekke. “Volatility and the Natural Resource Curse.” *Oxford Economic Papers* (2009), p. 027.

12 Arezki, Rabah, and Mustapha K. Nabli. “Natural Resources, Volatility, and Inclusive Growth: Perspectives from the Middle East and North Africa” (2012).

2. EXTRACTIVE RESOURCES AND AFRICAN ECONOMIES

This section provides evidence on the contribution of the extractive sector to GDP in a select number of African countries. We also identify channels through which the sector can expand domestic economic opportunities besides its direct contribution to GDP. The section also includes a survey of the literature on why resource abundance has not translated to growth prospects for some countries.

Over the years, the extractive resources in Africa, including oil, gas, mining and forestry, have contributed tremendously to output share and played a major role in export earnings. Available evidence suggests that 23 countries have about 10 per cent of annual output and 50 per cent of their annual exports coming from extractive resources.¹³ For sub-Saharan Africa, despite the high per capita real GDP since 2000, the populations of these resource-rich countries are yet to experience higher standards of living from the rent accumulation. While oil exporters such as Libya, Algeria, Nigeria, Angola, Congo, Gabon, Equatorial Guinea, Cameroon and Chad contribute more than half of the total resource exports of Africa, other resource countries obtain at least 20 per cent of their export earnings from mining.¹⁴ Sierra Leone, Guinea, Namibia and the Democratic Republic of Congo obtain their export earnings from a variety of extractive resources. Zambia and Niger, however, are heavily dependent on Uranium and other base metals.

Table 1 shows the relative importance of the sector. The selected countries presented in the table have total natural resource contribution ranging from 3.8 per cent of GDP in Botswana to 73.4 per cent in the Congo Republic. Further examination of the extractive sector (oil, natural gas, and minerals) shows its contribution to GDP – for example, Congo's GDP draws mainly from oil (71 per cent). A number of countries derive more than 40 per cent of their GDP from oil. These include Equatorial Guinea (47.9 per cent), Gabon (42.8 per cent), and Angola (42.6 per cent). The contribution to GDP from minerals is comparatively much lower with the Democratic Republic of Congo (23.5 per cent) and Zambia (20.1 per cent) being the leaders. Comparing

13 Lundgren, Charlotte J., Mr Alun H. Thomas, and Mr Robert C. York. *Boom, Bust or Prosperity? Managing Sub-Saharan Africa's Natural Resource Wealth*. International Monetary Fund, 2013.

14 Van der Ploeg & Poelhekke (n 12).

sub-Saharan Africa as a whole to other regions in the world, it would be seen that rents accruing from extractive resources in 2012 were 16.2 per cent and only slightly below the 20.9 per cent of the Middle East and the North Africa region. This indicates that sub-Saharan Africa in 2012 received resource rents greater than the 9.8 per cent average of the world.¹⁵

A broader perspective indicates that besides its direct contribution to GDP, the channels through which the extractive sector expands domestic economic opportunities are well known. Wise & Shtylla (2007)¹⁶ outline four of these. First, through the procurement of goods and services, extractive industries, which are inherently capital intensive, most often face pressure to turn to local suppliers to procure goods and services. According to Wise & Shtylla,¹⁷ even though the traditional extractive companies (mostly foreign) import machinery, equipment and other inputs into the domestic countries, the vast increase and changes in the contracts of these companies now oblige them to in source these inputs. In doing so, economic opportunities are expanded and resource-rich countries' benefits will not only be limited to revenues from extraction but also from new domestic economic opportunities from the procurements of goods and services.

Second, extractive companies often use local distributors, suppliers and retailers as intermediaries to meet their needs when procuring goods and services. This is especially the case for downstream activities in the oil, gas and minerals sectors. For instance, "Total, a leader in downstream operations in Africa with a market share of 24.5 per cent, operated seven refineries and 3,750 service stations as of 2005, employing 8500 mostly national staff".¹⁸ Many countries like Ghana are designing policies that require companies in the extractive industry to strengthen their local content in this regard.

Third, while the extractive sector is typically not known to be labour intensive, employment opportunities are available during the

15 Lee, Munseob, and Cheikh Anta Gueye. "Do Resource Windfalls Improve the Standard of Living in Sub-Saharan African Countries? Evidence from a Panel of Countries" (2015).

16 Wyse, Holly, and Sokol Shtylla. "The Role of the Extractive Sector in Expanding Economic Opportunity." *Harvard University: Economic Opportunity Series* (2007).

17 Wise & Shtylla (n 17).

18 Ibid.

construction phases of the projects. In addition, these jobs quite often pay higher salaries than the economy-wide averages. In scouting for potential employees, companies directly invest in technical and tertiary education targeting fields such as mining engineers, geologist, petroleum engineering, among others. This decision provides human capital development to the benefit of resource-rich countries. Beneficiaries of this training will be able use these skills elsewhere when and if these companies fold up their operations. These employment opportunities therefore do lead to better economic welfare of the people.

Table 1. Extractive Industries' Contribution to GDP

Country	Total Natural Resources	% of GDP (2013)			
		Oil	Natural Gas	Minerals	Forests
Algeria	28.2	21.6	6.1	0.1	0.3
Angola	35.0	34.6			0.4
Botswana	3.2			2.2	0.4
Cameroon	9.1	5.5	0.2	0.2	3.2
Chad	27.8	23.3			4.5
Congo Republic	59.8	56.8			2.9
Democratic Rep. of Congo	40.0	2.5		18.6	19.0
Côte d'Ivoire	8.4	3.6	0.8	1.4	2.5
Egypt	10.9	7.0	3.0	0.3	0.5
Equatorial Guinea	53.9	53.3			0.6
Ethiopia	15.8			1.1	14.7
Gabon	46.2	42.4	0.3	0.1	3.4
Ghana	17.6	6.2		5.7	5.7
Guinea	23.6			9.9	13.7
Liberia	29.7			0.7	29.0
Libya	47.0	44.2	2.7		0.2
Mali	13.3			9.4	3.9
Mozambique	15.7	0.1	4.1	0.1	8.3
Nigeria	15.6	13.6	0.9		1.1
Sierra Leone	7.9			0.3	7.6
South Africa	9.2			3.7	0.6
South Sudan	28.1	25.8			2.3
Sudan	8.9	5.6		1.7	1.6
Tanzania	7.9		0.3	3.6	4.0
Tunisia	6.2	4.1	1.0	0.8	0.4
Zambia	19.5			16.5	2.9
Zimbabwe	11.7			5.4	4.2

Source: *World Development Indicators*, The World Bank 2015.

Fourth, and in accordance to their codes of ethics, most companies engage in corporate social responsibility. This investment in social and community philanthropy provides links with other sectors of the economy (agriculture, transport, telecommunications, finance, health, education, environment and sports). These links can “create local economic opportunity and generate medium-term benefit for extractive companies”.¹⁹ Put together these social and community investments tend to empower the poor when done conscientiously.

Following the statistics in Table 1, it would be expected that the high revenue obtained from Africa’s extractive industries would translate to growth and better living standards for its citizenry. Unfortunately, this has not been the case for most countries on the continent. Most of the resource-rich countries still face high levels of poverty, inequality, poor sanitation, poor health system, illiteracy, and low human capital formation. As a result, a lot of studies have focused on the resource curse phenomenon. Most of such works were motivated by the works of Sachs & Warner,^{20,21,22} who found that countries with natural resources are more likely to have delayed growth compared to resource-scarce countries.

Furthermore, other works have attributed several reasons for the poor growth observed in Africa’s resource-rich countries. Mehlum et al (2006)²³ lame this on poor institutions due to deficient governance practices while Arezki & van der Ploeg (2007)²⁴ believe the exportation of natural resources further worsens the quality of institutions, resulting in the slow growth observed in resource-rich countries. Also, in situations where well defined property rights are missing, the extractive industries can attract the common pool problem which causes rent-

19 Ibid.

20 Sachs, Jeffrey D. and Andrew M. Warner. *Natural Resource Abundance and Economic Growth*, No. w5398. National Bureau of Economic Research, 1995.

21 Sachs, Jeffrey D. and Andrew M. Warner. “Sources of Slow Growth in African economies.” *Journal of African Economies*, 6, No. 3 (1997): 335-376.

22 Sachs, Jeffrey D. and Andrew M. Warner. “The Curse of Natural Resources.” *European Economic Review*, 45, Mo. 4 (2001): 827-838.

23 Mehlum, Halvor, Karl Moene and Ragnar Torvik. “Institutions and the Resource Curse.” *The Economic Journal*, 116, No. 508 (2006): 1-20.

24 Arezki, Rabah, and Rick van der Ploeg. “Can the Natural Resource Curse Be Turned into a Blessing? The Role of Trade Policies and Institutions” (2007).

seeking behaviour and corruption, leading to a deterioration in growth levels of such countries.^{25,26,27,28,29,30,31}

It has been argued that the tendency of resource-rich countries to increase borrowings during boom periods (when commodity prices are high) is more likely. This often results in such countries running into crises when commodity prices fall, thereby affecting economic growth.³² Also in the quest to provide a better life for their citizens, African countries engage in subsidies and welfare policies, which are not sustainable when these resources diminish in quantity or completely run out.³³ Van der Ploeg's (2011)³⁴ review of extant literature shows an inverse relationship between resource abundance and economic growth.

Despite these unpleasant characteristics experienced in Africa's resource-rich SSA countries, there are few exceptions. Over the years, Botswana, the world's leading diamond producer, has defied the odds of the resource curse and performed remarkably well in terms of acceleration of economic growth. It is impressive to note that this land-locked country which attained independence in the 1966 with extreme low GDP per capita levels – poor road networks, inadequate

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- 25 Lane, Philip R. and Aaron Tornell. "Power, Growth, and the Voracity Effect." *Journal of Economic Growth*, 1, No. 2 (1996): 213-241.
- 26 Tornell, Aaron, and Philip R. Lane. "The Voracity Effect." *American Economic Review* (1999), 22-46.
- 27 Auty, Richard M. *Resource and Economic Development*, Oxford University Press, Oxford (2001).
- 28 Isham, Jonathan, Michael Woolcock, Lant Pritchett and Gwen Busby. "The Varieties of Rentier Experience: How Natural Resource Export Structures Affect the Political Economy of Economic Growth" (2002) <www.middlebury.edu/NR/rdonlyres/23035072-BFD1-43A1-923C-9CF11831F32/0/0308.pdf> accessed 31 January 2016.
- 29 Torvik, Ragnar. "Natural Resources, Rent Seeking and Welfare." *Journal of Development Economics*, 67, No. 2 (2002): 455-470.
- 30 Isham, Jonathan, Michael Woolcock, Lant Pritchett and Gwen Busby, The Varieties of Resource Experience: How Natural Resource Export Structures Affect the Political Economy of Economic Growth. *Middlebury College Economics Discussion Paper* No. 03-08 (2003).
- 31 Caselli, Francesco. "Power Struggles and the Natural Resource Curse" (2006).
- 32 Mansoorian, Arman. "Resource Discoveries and Excessive External Borrowing." *The Economic Journal*, 101, No. 409 (1991): 1497-1509.
- 33 Mansoorian (n 33).
- 34 Van der Ploeg, Frederick. "Natural Resources: Curse or Blessing?" *Journal of Economic Literature*, 49, No. 2 (2011): 366-420.

infrastructure, poor electricity, telephone, water, and sewage systems with only 22 university graduates – could attain an upper-middle income status after the discovery of diamonds.³⁵ In 2013, Botswana’s diamonds contributed about 80 per cent exports and one-fifth of output.³⁶ Its GDP per capita moved from US\$3,500 in 1980 to about US\$12,500, accounting for about 4.3 per cent annual growth rate.³⁷ Table 2 presents some of Botswana’s social and economic indicators.

Table 2. Selected Social and Economic indicators of Botswana for Five Decades

	GDP per capita	Real GDP per capita growth	Gross fixed Capital Formation	Life Expectancy at Birth	Mortality rate infant
	Constant 2000 U.S. dollars	In percent	In percent of GDP	Total in years	Per 1,000 live births
1960s	24	4.7	22.9	52	104
1970s	757	10.9	33.9	57	76
1980s	1,592	7.5	29.0	63	51
1990s	2593	3.1	27.2	59	55
2000s	3,778	2.5	24.7	51	49

Sources: World Bank; World Development Indicators; and IMF staff estimates (Adopted from IMF 2012).

Over the years, Botswana has been commended for its good governance, transparent political process, sound fiscal system, quality and acceptable regulation, low level of corruption and its ability to manage the huge revenues obtained from its extractive industries.³⁸

35 Acemoglu, Daron, Simon Johnson & James. A. Robinson. “An African Success Story: Botswana”, in D. Rodrik (ed.), *Search of Prosperity: Analytic Narratives on Economic Growth*, Princeton: Princeton University Press (2003).

36 African Development Bank, Organization for Economic Cooperation and Development and United Nations Development Programme, *African Economic Outlook*, 2015.

37 International Monetary Fund *Macroeconomic Policy Frameworks for Resource-rich Developing Countries*. Background Paper 1, Supplement 1 (2012).

38 *ibid.*

The country has been able to diversify its resource revenues concentrating more on investment spending. Leith (2005)³⁹ indicated that Botswana invested over 25 per cent of its GDP and spent close to 40 per cent of its total revenues on human capital and infrastructure over the past decades. The country also accumulates high foreign exchange reserves from its resource rents which allow it to absorb the shocks in the commodity markets when prices of natural resources fall.⁴⁰ These characteristics explain the sustainable and continuous growth enjoyed by Botswana. It also emphasizes why Botswana is seen as the best performer in sub-Saharan Africa.

3. SOURCES OF GLOBAL VOLATILITY

Observable from the earlier sections, most African resource-rich countries specialize in the exportation of primary commodities mainly from their extractive industries. As a result, their budget requirements depend heavily on the revenues from these commodities. They are, therefore, at the mercy of commodity price volatility and macroeconomic instability consequently dampening growth in such countries. This has been the fundamental reason behind the resource curse school of thought. Most studies on this phenomenon attribute the poor economic growth to over-dependence or the sheer abundance of extractive industries ignoring the effects of volatility sources or channels. In this section, we explore these sources of global volatility and examine how they could hamper economic growth.

The inelastic behaviour of commodity prices can be identified as a major source of volatility.⁴¹ Compared to the prices of other goods and services in the economy, commodity prices are more volatile because global demand and supply of commodities in the short term are price inelastic. For instance, it takes the extractive companies ample time to increase production through the increase of mineral exploration,

39 Leith, James Clark. *Why Botswana Prospered*. McGill-Queen's Press-MQUP, 2005.

40 Maipose, Gervase S. *Policy and institutional dynamics of sustained development in Botswana*. International Bank for Reconstruction and Development/The World Bank, 2008.

41 Dwyer, Alexandra, George Gardner and Thomas Williams. "Global Commodity Markets-Price Volatility And Financialisation". *RBA Bulletin*, June (2011): 49-57.

discoveries of new technologies or the building of new mines. In the same way it takes time for consumers to change their tastes and preferences or habits (example: shifting from the use of gas to electricity). This suggests that the response to demand and supply shocks are more likely to result in movements of commodity prices in order to attain equilibrium in the market.

Furthermore, Caballero et al (2008)⁴² argue that lack of a global stable or safe asset could be the cause of commodity price volatility. According to Arezki et al (2011)⁴³ commodities “are goods that retain their qualities over time, which allows economic agents to use them as financial assets”. Gold, diamonds and other extractive resources are ready examples in this regard. However, the act of storing or stockpiling with the intention to be used in times of scarcity cause inelastic supply and shortages which affect the stability of these commodities, resulting in high price volatilities and affecting economic growth.⁴⁴

International price fluctuations, which are driven by worldwide demand and supply forces, also have significant effects on commodity prices. These price fluctuations affect commodity-exporting countries through fluctuations in their terms of trade, which also cause volatility in real exchange rates. An increase in exchange rate volatility worsens economic growth by negatively affecting investment and consumption decisions of private agents. Hedging against exchange rate volatility becomes costlier for private agents. Once firms are unable to hedge against exchange rate volatility, export-oriented sectors are negatively affected and growth in the economy dampens.⁴⁵ An increase in exchange rate volatility can create opportunities in the profit of firms only if they can protect themselves from negative effects of hedging. In other words, if firms or countries have the ability to adjust trade volumes to movements in the exchange rate then they can protect themselves from any negative effect. The trend actually worsens given that the export

42 Caballero, Ricardo J., Emmanuel Farhi and Pierre-Olivier Gourinchas. *Financial Crash, Commodity Prices and Global Imbalances*, No. w14521. National Bureau of Economic Research, 2008.

43 Arezki, Rabah, Daniel Lederman and Hongyan Zhao. “The Relative Volatility of Commodity Prices: A Reappraisal.” *Policy* (2011).

44 Deaton, Angus and Guy Laroque. “On the Behaviour of Commodity Prices.” *The Review of Economic Studies*, 59, No. 1 (1992): 1-23.

45 Raddatz, C. 2011. Over The Hedge: Exchange Rate Volatility, Commodity Price Correlations, and the Structure of Trade, *Policy Research Working Paper Series* 5590, The World Bank.

of commodities involve the exchange of currencies in the international market, therefore, any persistent fluctuation in the exchange rate will adversely affect commodity price, causing volatility in commodity prices as well.

Hooper and Kohl Hagen (1978)⁴⁶ and Cerbaf (1985)⁴⁷ analysed the theoretical relationship between exchange rate volatility and international trade. Their argument is that the higher cost for risk-averse traders is associated with higher exchange rate volatility which leads to less foreign trade. They also pointed out that the exchange rate is agreed upon at the time of trade contract, but payment is not made until future delivery actually takes place. Therefore, if due to rapid fluctuations, exchange rates become unpredictable, traders would become uncertain about their profits, which would in effect reduce the benefit of international trade.

Another medium through which exchange rate volatility caused by fluctuations in the terms of trades can affect growth is investment. Exchange rate affects investment through domestic and export sales. With currency depreciation, goods domestically produced become less expensive compared to foreign goods. This results in an increase in demand for domestic goods. In the same way exports will increase because they have become cheaper. For a given capital and labour, marginal revenue products of capital and labour increase as a result of convenient demand situations. The firm reacts by increasing its investment in capital and, consequently, in labour.⁴⁸ Also, exchange rate affects investment through the price of imported inputs. Depreciation raises total production costs and results in lower marginal profitability of commodities. The effect of the exchange rate on the marginal profitability is proportional to the share of imported inputs into production.⁴⁹

46 Hooper, Peter, and Steven W. Kohlhagen. "The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade." *Journal of International Economics*, 8, No. 4 (1978): 483-511.

47 Cerbaf. *Exchange Rate Volatility and World Trade*: International Monetary Fund, *Occasional Paper No. 28* (IMF, Washington, DC, 1984).

48 Campa, Jose Manuel and Linda S. Goldberg. "Investment, Pass Through, and Exchange Rates: A Cross Country Comparison." *International Economic Review*, 40, No. 2 (1999): 287-314.

49 Nucci, Francesco, and Alberto F. Pozzolo. "Investment and the Exchange Rate: An Analysis with Firm-Level Panel Data." *European Economic Review*, 45, No. 2 (2001): 259-283.

The growth rate of per capita real GDP in the US also provides signals for the global economic conditions. Putnam (2015)⁵⁰ has identified six potential sources of global volatility in this regard. They are US rates, US treasury bond yields, US equities, crude oil, gold and Euro. Decisions on the rise or fall of US rates depend mostly on good timing, however, the information asymmetry existing (due to the difficulty involved in obtaining data) in the markets has led to great uncertainties. The potential result is that short-term real interest rates in the US that reflect the cost of borrowing in the international market may lead to price movements about a trend.

One of the most important drivers of global economy is crude oil. Any changes to the price of oil affect welfare and growth globally. Exogenous effects, such as conflicts, political instability, natural disasters and so on can disrupt supply and affect the global oil price. The persistent conflicts and instability in the exporting countries, for instance, Congo and the difficulty and time it takes to discover new reserves cause fluctuations in oil prices. Since oil is a major source of energy in most countries, fluctuations in its prices does not only cause fluctuations in the revenues of these exporting countries but also leads to a decrease in the welfare of consumers and in totality affects economic growth.

Finally, stock market returns, which reflect global financial conditions, can be a source of the volatility of commodity prices. Many authors^{51,52,53} have shown the causal connection between the growth trend of output and the volatility of output around that trend. The overwhelming conclusion is that macroeconomic volatility has negative (adverse) consequences on economic growth although other studies argue otherwise. There are a number of channels through which volatility affects (mostly negatively) growth. Fluctuating commodity prices increases uncertainty and risk and, therefore, discourages investment, which could have direct negative consequences on

50 Putnam, B., Six Sources of Upcoming Volatility, CME Group Brief (2015).

51 Aghion, Phillipe and Abhijit, Banerjee. *Volatility and Growth*. Oxford and New York: Oxford University Press (2005).

52 Ramey, Garey and Valerie A. Ramey. *Cross-Country Evidence on the Link between Volatility and Growth*, No. w4959. National Bureau of Economic Research, 1994.

53 Arezki, Rabah, and Thorvaldur Gylfason. "Chapter 2 Commodity Price Volatility, Democracy, and Economic Growth." In *Economic Growth and Development*, pp. 9-24. Emerald Group Publishing Limited, 2011.

economic growth. Similarly, when these fluctuations lead to a decline in the terms of trade, this could translate into a decline in fiscal revenues for the state with direct effect on economic growth.

Another channel, as shown by Arezki & Nabli,⁵⁴ is related to the implications on saving/investment decisions by state and non-state actors that could affect economic performance. Significant and relevant here is how these revenues that pass through governments' coffers may be prone to rent-seeking by the state and other key actors. UNCTAD⁵⁵ provides an extensive discussion of the impact of commodity price volatility on economic growth.

4. THE VOLATILITY-GROWTH NEXUS

Volatility measures the variation (persistence rise or fall) of a parameter, which could be price or growth rate over time. It is not a directional measure but that of dispersion. It involves evaluating the deviation between the values of a parameter and its equilibrium value; hence the distribution of the variable around its mean or trend. The measure is very important in risk management. Volatility-growth nexus can simply be defined as the relationship that exists between volatility and growth. This section provides evidence on the volatility-growth nexus by estimating volatility persistence for a select number of African countries.

Most developing countries are known to be among the world's most volatile countries, including small countries like Togo and Dominican Republic as well as large countries like Argentina and China. Among these volatile countries are a number of resource-rich or commodity-dependent countries like Nigeria. The list also includes growing industrialized countries.

Given our discussions in the above sections, there is enough reason to believe that volatility and growth are related. But no consensus has been reached in the literature on whether volatility affects growth negatively or positively. While cross-country correlations show a negative relationship between volatility and growth, the disaggregation of these countries into poor countries middle-income countries and developed

54 Arezki & Nabli (n 13).

55 UNCTAD (n 6).

countries shows totally different results.⁵⁶ The relationship between volatility and growth for developed countries is positive, negative for less developed countries and almost zero for middle income countries. Furthermore, limiting the scope to African countries, we realize that the few studies conducted on the subject are limited to volatility and other macroeconomic variables such as investment, trade, exports and not necessarily growth. For instance, Kyereboah-Coleman and Agyire-Tettey⁵⁷ and Osinubi and Amaghionyeodiwe⁵⁸ investigated the effect of volatility on foreign direct investment in sub-Saharan Africa and Nigeria, respectively. The studies concluded that volatility and foreign direct investment were negatively related. It is against this background that we empirically explore volatility-growth-nexus in this section focusing on 18 commodity exporting countries (Congo, Angola, Algeria, Gabon, Equatorial Guinea, Zimbabwe, Tunisia, Mali, Libya, Egypt, Cote d'Ivoire, South Africa, Mozambique, Sudan, Congo D.R. and Ghana).

We start by looking at the volatility trends in growth and commodity prices mainly of gold and crude oil in these countries using the World Development Indicators (2014) dataset from 1982 to 2013. Figure 1 shows how volatile commodity prices are compared to their corresponding growth values. The figure shows a steady decrease in the prices of gold during the 1980s rising through the 2000s until they reached a peak in 2011, after which it began a sharp decline. The price of crude oil on the other hand saw a slow decline for a decade (1986-1996) after which it increased but was unable to sustain this increase due to the 2008 global financial crisis. Although it picked up again in 2010, it again faced a massive fall in prices in 2015.

The fluctuations in commodity prices are seen to affect the stability of growth, resulting in the volatility in growth too as depicted in Figure 1.

56 Hnatkovska V. and N. Loayza, Volatility and Growth Policy. *Policy Research Working Paper Series* 3184, The World Bank (2003).

57 Kyereboah-Coleman, Anthony and Kwame F. Agyire-Tettey. "Effect of Exchange-Rate Volatility on Foreign Direct Investment in Sub-Saharan Africa: The Case of Ghana." *The Journal of Risk Finance*. 9, No. 1 (2008): 52-70.

58 Osinubi, Tokunbo, S. and Lloyd, A. Amaghionyeodiwe. "Foreign Direct Investment and Exchange Rate Volatility in Nigeria." *International Journal of Applied Econometrics and Quantitative Studies*, 6, No. 2 (2009): 83-116.

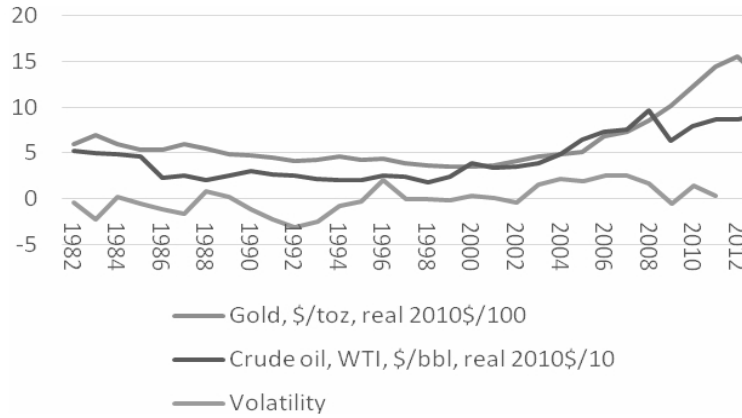


Figure 1. Commodity Prices and Volatility

A scatter plot of average growth for the entire period against the volatility of growth measured through its standard deviation in Figure 2 clearly shows a high concentration of countries with low growth rates and low volatility. The majority of these countries experienced average growth rates around 5 per cent and their estimated volatilities did not exceed 10 per cent (using the standard deviation of growth rate). Two countries, namely, Equatorial Guinea and Libya, are exceptions. Libya has high growth rate volatility (about 34 per cent) and an average growth rate around 5 per cent.

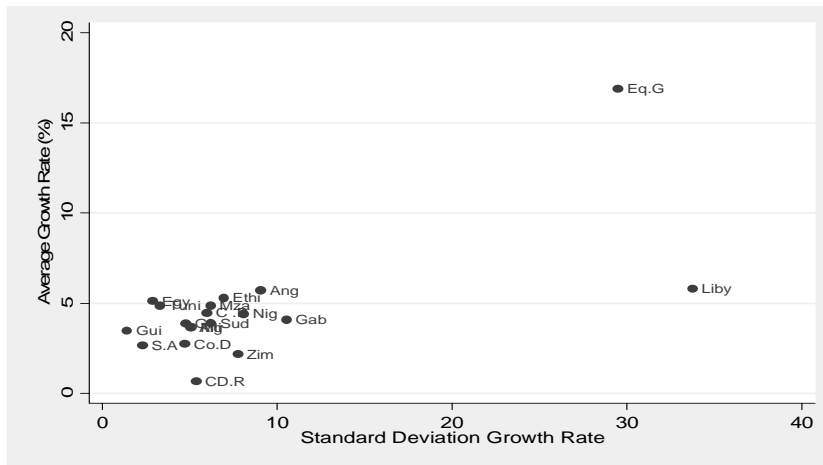


Figure 2. Growth and Volatility

Equatorial Guinea experienced both high growth volatility and high average growth rate during the same period. In the case of countries with high volatility, a suitable possible prescription is for higher precautionary saving rates. That is, such countries could operate a sinking fund where some percentage of their revenues obtained from commodities exports is stored and used when revenues are unable to support national budgets due to various volatility sources.

The panels in Appendix 1 depict the visual relation between GDP and prices of crude oil (Angola, Algeria, Nigeria, Libya, and Egypt) and gold (Ghana, Mali, South and Guinea). It is evident that the growth rates in the respective countries do not necessarily follow the observed increases in the prices of the commodities. It can be argued that, in the absence of statistical estimation, the revenues do not translate to growth in the economies.

We undertook a regression analysis aimed at explaining GDP growth in a total of 18 selected countries in Africa (see Table 1 for the countries involved). Data covering 1970 to 2013 was obtained from the World Development Indicators (2013). We used panel estimation technique involving 817 observations. The variables used for the estimation were GDP per capita, volatility of GDP growth, oil rents (percentage of GDP), terms of trade adjustment (constant LCU) and natural gas rents (percentage of GDP).

Three major approaches can be used in measuring volatility. First, it can be calculated as the standard deviation of the growth of a variable. Second, it can be estimated as the standard deviation of the residual of an econometric regression of the Generalized Auto Regressive Conditional Heteroscedastic (GARCH) and Exponential Generalized Autoregressive Conditional Heteroscedastic (EGARCH) types. Third, it can be represented by the standard deviation of the cycle isolated by statistical filter. Cariolle⁵⁹ provides a detailed coverage of the measuring of macroeconomic volatility. For the purposes of this work, the GARCH is employed. Table 3 captures the summary statistics of data used.

59 Cariolle, Joël. *Measuring Macroeconomic Volatility – Applications to Export Revenue Data, 1970-2005*. No. I14. (2012).

Table 3: Summary statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
GDP per capita	20.56	1.12	4.72	9.52
Volatility	0.43	0.84	-0.99	11.21
Oil Rent	10.44	16.66	0	79.27
Terms of Trade	20.11	4.76	10.81	27.74
Natural Gas Rent	0.89	2.48	0	21.25

The results of the regression analysis are presented in Table 4 for both the Difference and System Generalized Methods of Moments (GMM) estimations. The results are consistent with our expectations of a negative relationship between volatility and GDP growth. In both models, the parameters are significant at a 0.01 per cent level. We also observe that all variables in the System equation including the lagged values of growth (LYL1) are significant in explaining GDP growth. In the Differenced equation the oil rent variable is not significant. While the terms-of-trade variable is significant in both equations, its effect in explaining GDP is consistently small in both equations.

Table 4. Difference and System Estimation of Economic Growth

Variables	Difference (GMM)	System (GMM)
LYL1	0.82 (25.78) ***	0.91 (28.62) ***
Volatility	-0.17 (-16.72) ***	-0.14 (-14.76) ***
Oil Rent	0.00 (0.88)	0.00 (7.41)***
Terms of Trade	1.17e-15 (2.22)**	1.01e-14 (2.43)**
Natural Gas Rents	0.00 (6.60)***	0.00 (3.21)***

Notes: ** $p < 0.05$; *** $P < 0.01$ [t-values are in parenthesis]

Observations	745	
AR-Test (order 1)	t = -7.938 P-value = 0.000	-
AR-Test (order 2)	t = -0.049 P-value = 0.6200	-
Sargan Test	Prob > chi ² = 0.058	Prob > chi ² = 0.000

Source: Authors' calculations.

Furthermore, the sum of the coefficient of the ARCH and GARCH terms in the estimation of volatility (see Appendix 2) enables us to measure the persistence in volatility shocks.^{60,61} When the sum of these two terms equals to one for any particular country, it means that the country's response to volatility shocks is at a slow pace. On the other hand, when the sum of the terms is lower than one it means countries easily adjust to volatility shocks. The benchmark takes the value of one, the closer the summed value is to one the slower the adjustment rate.

Volatility persistence in GDP growth for the resource-rich economies is captured in Table 5. For 12 out of the 18 selected countries, persistence measures were at least close to unity, indicating that most resource-rich countries in Africa find it difficult to adjust their economies back to equilibrium when hit with volatility shocks or changes in the volatility of GDP growth. While volatility persistence is highest in Congo, Angola, Algeria, Gabon, Equatorial Guinea, Zimbabwe, Tunisia, Mali, Libya, Egypt and Cote D'Ivoire, the level of GDP growth volatility is much lower in South Africa, Mozambique, Sudan, DRC and Ghana. Notably, the overall results on the panel indicate that most Africans that are blessed with extractive commodities are unable to respond at a faster rate when they face volatility shocks. This may be due to their total dependence on resource rents and their inability to invest their export revenues.

The empirical results attest to the presence of volatility in African economies. This has negative effects on economic growth in resource-rich African countries. Other determinants of growth, such as oil and gas rent and terms of trade, are also identified. Unfortunately, for such countries, it takes longer periods to adjust their economies when faced with volatility. The next section explores some policy options in this regard.

60 Agénor, Pierre-Richard, C. John McDermott, and Eswar S. Prasad. "Macroeconomic Fluctuations in Developing Countries: Some Stylized Facts." *The World Bank Economic Review* 14, No. 2 (2000): 251-285.

61 Canova, Fabio. "De-trending and Business Cycle Facts." *Journal of Monetary Economics* 41, No. 3 (1998): 475-512.

Table 5. Volatility Persistence in GDP Growth

Countries	Volatility Persistence ($\tau = \alpha_1 + \beta_1$)
Angola	0.7224
Algeria	0.9754
Congo Republic	1.2418
Ethiopia	1.0609
Gabon	1.0436
Ghana	0.3191
Guinea	0.5712
Equatorial Guinea	0.8280
Egypt	0.9421
Libya	0.8235
Mali	1.1516
Mozambique	0.3969
Nigeria	1.3231
Sudan	0.3852
South Africa	0.1244
Democratic Republic of Congo	0.4440
Zimbabwe	0.8594
Tunisia	0.9879
Cote D'Ivoire	0.6596
Panel	0.9781

Source: Authors' calculation.

5. MAKING THE BEST OF THE EXTRACTIVE SECTOR

In this section, we briefly examine what needs to be done for the extractive sector to play a transformational role in African economies, specifically in enhancing inclusive growth. The following discussion draws from documented experience worldwide.

First, there is an emerging trend in the continent to create revenue stabilization funds. These funds ensure macroeconomic stability and minimize real exchange rate fluctuations. Some countries have used these funds to boost savings by creating sovereign wealth funds (SWF). SWFs are growing very fast in Africa although they account for about

0.3 per cent of global SWF.⁶² SWF can promote domestic growth, help boost credit rating (as in the case of Angola), and lower borrowing cost on international markets. Leading SWFs in Africa are in Botswana (US\$6.9 billion), Angola (US\$5 billion) and Nigeria (US\$1 billion).⁶³ The key element in SWF is to enhance savings, which can eventually be used for infrastructural development, human capacity building and sustainable economic development.⁶⁴ Saving of resource income has been shown to be effective in helping resource-rich countries to escape the resource curse. Torvik⁶⁵ found that of 11 countries, which claimed to have escaped the resource curse, only one had negative saving rates. The same study shows that seven out of nine countries with negative saving rates had not escaped the resource curse.

Second, smoothing price fluctuations can ensure that price volatility is reduced. Policies that reduce high variability of prices would have direct effects on fiscal revenues. Lower volatility in resource revenues ensures stability in the available funds for economic development.

Third, a deliberate effort to promote inclusive growth can provide opportunities for the extractive sector. Equitable sharing of revenues and attacking inequalities in income are channels through which inclusive growth can be promoted. Using the SWF to support social protection programmes could be an effective mechanism to achieve inclusive growth.

Fourth, improving transparency and accountability is another key element. The lack of transparency and accountability leads to the presence of rent seekers and the increase in corruption. For the extractive sector to play an important role in economic growth, there should be increased transparency and accountability for all the state and non-state actors. Improved transparency and accountability will also play an important role in reducing conflicts that many resource-rich countries experience. Along with improving transparency and accountability is

62 Whitehead, E. Rise of the African Sovereign Wealth Fund, *This is Africa* (2012) <<http://www.thisisafricaonline.com>> accessed 25 November 2016.

63 Sovereign Wealth Fund Institute. 2015. <[http://www.swfinstitute.org./](http://www.swfinstitute.org/)> accessed 5 October 2016.

64 Dolphyne, M. A. Social Policy and State Revenues in Mineral-Rich Countries in Africa, in Afful-Koomson & Asubonteng (eds.), *Collaborative Governance in Extractive Industries in Africa*. United Nations University Institute for Natural Resources in Africa, Accra, Ghana (2013).

65 Torvik, Ragnar. "Why do some resource-abundant countries succeed while others do not?" *Oxford Review of Economic Policy* 25, No. 2 (2009): 241-256.

the need to improve the local participation in mineral resource development (Ibid. 55). Associated with this is the need for prudent financial management and fiscal discipline. Many a time countries initiate new projects simply because they discovered new extractive resources. It is important to manage the expectations of the population so as not to fall into the trap of over-commitment of expected resources.

Finally, resource-rich countries need to diversify their economies. A key strategy is to promote linkages with other sectors of the economy and to stimulate value addition⁶⁶ in the sector. SWF could catalyse economic diversification and ensure that growth prospects remain stable in the face of high volatility of resource rents. A policy option that aims to enhance economic diversification can, therefore, be seen to improve the growth trajectory of resource-rich countries.

6. CONCLUSION

Owing to the volatility of commodity prices, extractive resources revenues are highly volatile. Broadly speaking, international price fluctuations driven by worldwide demand and supply forces, growth rate of per capita real GDP in the US, short-term interest rates in the US (reflecting the cost of borrowing on the international market) and stock market returns (reflecting global financial conditions) are the other major sources of global volatility. Put together, these volatilities affect economic growth through a number of channels, including terms of trade, saving/investment and income distribution, inflation and exchange rates.

The extractive sector is making a very huge direct contribution to GDP in resource-rich countries in Africa. The sector also provides numerous domestic economic opportunities. The ability of the extractive resources to play a critical role on Africa's growth prospects hinges on efficient macroeconomic management. This can provide opportunities for countries to manage price fluctuations so as to achieve structural transformation and capital formation. Translating extractive resources extraction to economic growth and transformation requires coherent policies, fiscal discipline and strong institutional frameworks.

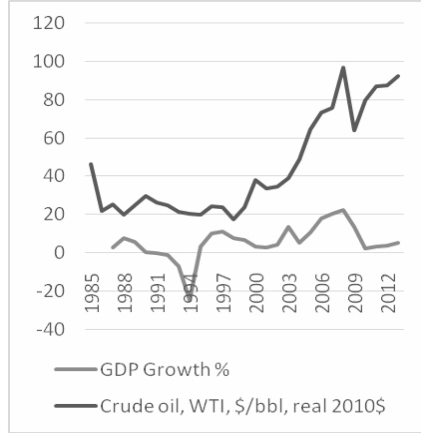
66 Bilal, S., I. Ramdoo, H.-B. Solignac-Lecomte & A. Pedro, "From Growth to Transformation: What Role for the Extractive Sector?" *GREAT Insights* 2(2). Maastricht: ECDPM (2013).

The evidence provided in this chapter suggests that volatility persistence in GDP growth for 12 out of the 18 selected countries were at least close to unity. This indicates that these resource-rich countries find it difficult to adjust their economies back to equilibrium when hit with volatility shocks or changes in the volatility of GDP growth.

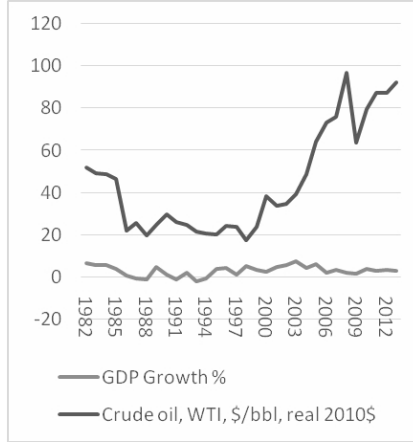
The discourse on the contribution of the extractive sector to growth needs to be cast in a broader context. Given the available knowledge, we propose a sustainable development framework buttressed by a paradigm centred on what we call the Six I's (ideas, incentives, innovations, institutions, infrastructure and implementation). The extractive sector will be poised to make unprecedented contribution to growth in Africa if each of the parameters of the framework is given careful attention. There will be need to develop new ideas on how to transfer wealth from mining companies to governments, for instance. The appropriate incentives that would enhance public private partnership in the sector are necessary. How these incentives lead to *innovations* in the management of the extractive sector is clearly important. The development of the *institutional* framework and required *infrastructure* are critical elements that can enhance productivity in the extractive sector. Finally, coherent strategies and mining visions exist but have not been adequately implemented. *Implementation* of strategies, visions and policies will go a long way to enable the extractive sector become a key player for sustained and inclusive growth.

Appendix I. Real Commodity Prices vis á vis Growth Rates, 1982 to 2013

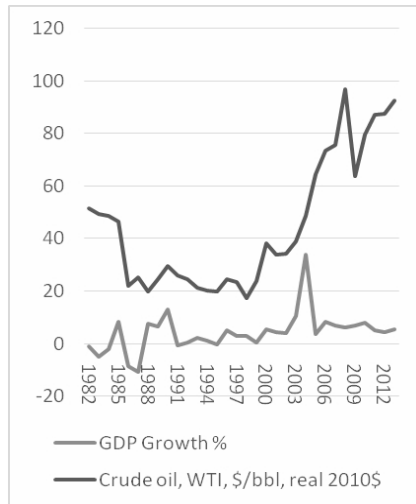
Angola (Crude Oil)



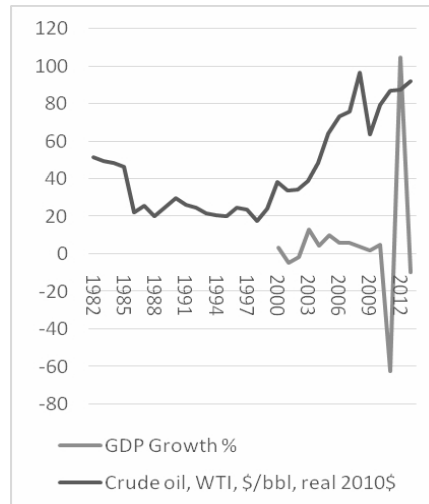
Algeria (Crude Oil)



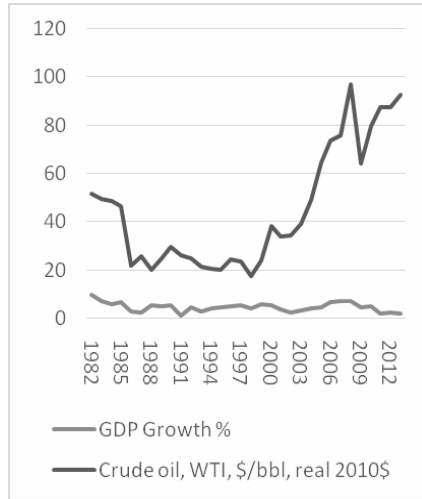
Nigeria (Crude oil)



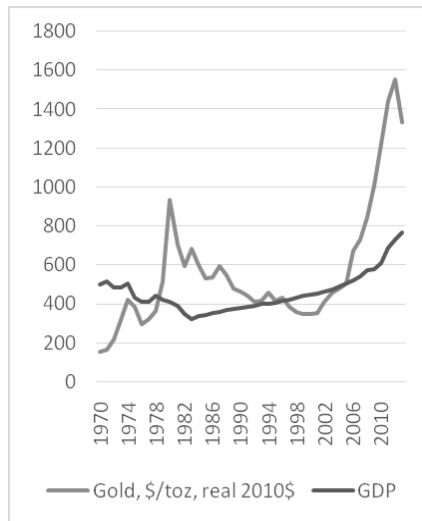
Libya (Crude oil)



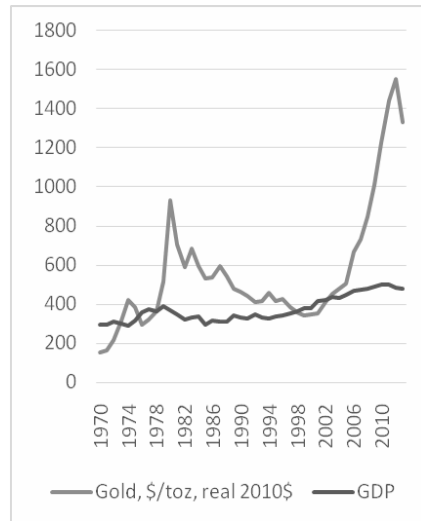
Egypt (Crude oil)



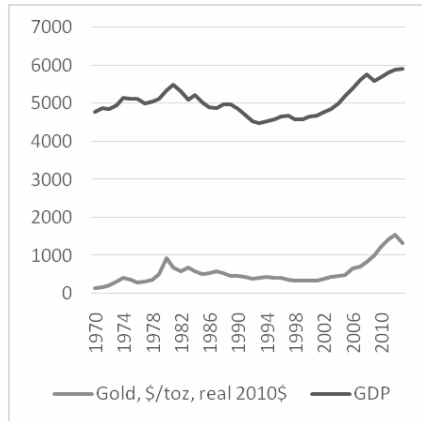
Ghana (Gold)



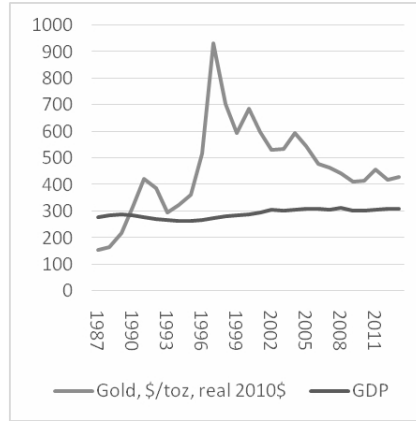
Mali (Gold)



South Africa (Gold)



Guinea (gold)



Appendix 2. Volatility Estimations

Dependent Variable: GDP_PER_CAPITA

Method: ML - ARCH (Marquardt) - Normal distribution

Sample: 1 836

Included observations: 836

$$\text{GARCH} = \text{C}(2) + \text{C}(3) * \text{RESID}(-1) ^ 2 + \text{C}(4) * \text{GARCH}(-1)$$

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	449.4067	2.688777	167.1417	0.0000
Variance Equation				
C	25544.10	2491.211	10.25369	0.0000
RESID(-1) ^ 2	1.465732	0.028651	51.15848	0.0000
GARCH(-1)	-0.000765	0.005960	-0.128417	0.8978
R-squared	-0.277753	Mean dependent var		1670.540
Adjusted R-squared	-0.277753	S.D. dependent var		2318.427
S.E. of regression	2620.697	Akaike info criterion		15.88115
Sum squared resid	5.73E+09	Schwarz criterion		15.90378
Log likelihood	-6634.322	Hannan-Quinn criter.		15.88983
Durbin-Watson stat	0.074475			

Heteroskedasticity Test: ARCH

F-statistic	0.000531	Prob. F(1,833)	0.9816
Obs*R-squared	0.000532	Prob. Chi-Square(1)	0.9816

Test Equation:

Dependent Variable: WGT_RESID ²

Method: Least Squares

Date: 05/11/15 Time: 19:16

Sample (adjusted): 2 836

Included observations: 835 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.868070	0.200257	4.334769	0.0000
WGT_RESID ² (-1)	0.000799	0.034648	0.023047	0.9816
R-squared	0.000001	Mean dependent var		0.868763
Adjusted R-squared	-0.001200	S.D. dependent var		5.717571
S.E. of regression	5.721000	Akaike info criterion		6.328557
Sum squared resid	27263.96	Schwarz criterion		6.339880
Log likelihood	-2640.172	Hannan-Quinn criter.		6.332898
F-statistic	0.000531	Durbin-Watson stat		2.000002
Prob(F-statistic)	0.981618			