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The Brunt of Oil Demand and US-Dollar Exchange Rate: Evidence from Net-Oil Importing Countries in Sub-Saharan Africa.

Abstract:

The objective of this paper is to investigate the impact of the US dollar exchange rate on oil demand in net importing oil countries of Sub-Saharan Africa. Given that Global real Crude oil prices are exclusively denominated in US dollars, therefore, we tests the hypothesis that, the variation in the dollar exchange rate affect the demand for crude oil in net imported oil countries whose currency, non-US dollars are used to buy petroleum products in the world and domestic market[1] of oil. This important because, when oil prices are at record levels in dollar terms, generally the price of oil in euro lags behind and won't increase until few month later but not in other currencies. We use a multivariate specification of error correction model and test for non-linearity issues pertaining to the effect of US-dollar exchange rate on oil demand. The results are analyze via the impact of US-Dollars exchange rate on the of terms of trade, firms performances and farm household productivity

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[1] (See, De Schryder, S., & Peersman (2014), G; Austvik (1987), Gately & Huntington (2002), Cooper (2003), Dargay, Gately and Huntington (2007), Narayan and Smyth (2007), Dargay and Gately (2010).

I. Introduction

In net importing oil countries such as those in Sub Saharan Africa (SSA) in general and in the West African Monetary union in particular, the impact of the US dollar exchange rate on oil demand (consumption) has not been studied in the literature. As a result, this paper focuses exclusively on net oil importing countries in Sub-Saharan Africa for two reasons.

First net oil-importing countries in SSA import crude oil using in US-dollars exchange rate facing subsequent oil prices volatility which directly or indirectly lead an appreciation of oil exporter's currencies and hence the US dollars. In this context, net oil importing countries would generally dip into their foreign exchange reserve (savings) to cover a random and temporary or permanent increases in the price of oil while struggling to sustain their consumption (oil) and investment in their economies. This is very important for countries, for net-oil importing countries in SSA like Kenya, Cote d'Ivoire, Senegal, and Ethiopia which spend more than 20 percent of their import bill to buy oil. However, since July 2014, the consistent decrease of oil prices has also contributed to an abrupt depreciation of many oil-exporting countries like, Russia (rouble), Nigeria (naira), etc. . . Therefore, even in oil exporting countries, US-dollars exchange rate has not made it easier to adjust to frequent swings in the price of oil (Gately &Huntington 2002, De Schryder, S., & Peersman, G; Austvik 1987, Gately & Huntington 2002, Cooper 2003, Dargay, Gately and Huntington 2007, Narayan and Smyth 2007, Dargay and Gately 2010). Schryder & Peersman (2012); Austvik (1987) concurred with Gately & Huntington (2002) and posits that price elasticity is higher for US-dollars exchange rate appreciation versus depreciation.

Second, if exchange rate matters a lot for net oil importing countries in SSA, therefore, any variation in the US-dollars exchange rate could shift up or down oil consumption likewise any shift in the oil price driven by supply and demand (Austvick, 1987; De Schryder & Peersman; Austvik, 2012). For instance, the cost of energy particularly electricity generated by imported liquid fuel-based thermal plants in net-oil importing countries of SSA has been, unaffordable to consumers who consumes the highest proportion of electricity supply. Therefore, from a microeconomic stand point, the direct impact of crude oil volatility would affects household revenue via different canvas such as food and electricity consumption, which have oil as an intermediate input in for their production in SSA. From a macroeconomic stand point, small business and farm household that rely entirely on energy and transportation are facing unreliable energy supply because of transport cost, high pressure on fertilizers input and diesel to operate agricultural machinery making production of food, good, and services more expensive while cutting backs jobs, stalled economic growth and increasing unemployment and poverty. Consequently, this has tremendous impact on poverty alleviation, Foreign Direct Investment (FDI), and national security in the same way as the plunge in oil prices since June 2014 and the appreciation of the US Dollars exchange rate is expected to boost consumer spending, firm's investment in SSA where growth is forecast to be 5 percent in 2015 from 4.5 percent in 2014.

However, the paradox is "The African continent is well endowed with energy resources but most remain untapped", while power shortages have become one of the biggest impediment on economic development in net oil importing countries in SSA African, World Bank (2012). Therefore, while, its important to seek long term alternative source of energy, it is equally

important to evaluate and estimate the impact of US-dollars exchange rate denomination of oil price in SSA, as energy needs rise with growing economies and populations in net oil importing countries of Sub-Saharan Africa. In 2005, "The strengthening of the U.S. dollar vis-à-vis the euro has driven import prices up in the CFA franc countries of Sub Saharan Africa" (p.1, 2005, IMF). Therefore, energy dependent economies in SSA continue to see their terms of trade deteriorating, and their social and economic progress tied intrinsically to the variation of crude oil prices variations linked to the US-dollars exchange rate, which we are formally examining in this paper. Fist, this paper contributes to the scant literature in SSA by suggesting that energy price and US dollars exchange rate changes can account for innovations in major macroeconomic variables in net importing oil countries of SSA. This is very important in net oil importing countries in SSA where affordable, accessible and reliable energy source and food security is sine qua non to unleash the faster economic and social development well expected. Sibanda and Mlambo (2014) point out the gap in the literature showing that "the impact of oil prices on exchange rates has been studied to a greater extent in the oil producing countries but less has been done for oil-importing small open countries (p, 194, 2014). The above authors follow up by arguing that although, the link between exchange rate and oil prices has been investigated, in oil exporting countries in the OECD region, the findings cannot be generalized to net oil-importing countries of SSA. Second contributions of this paper is that our findings show the extent to which the swings in the US dollar exchange rate is driving global oil prices, and hence net oil importing countries in SSA'S consumption of oil and growth prospect in the global economy. Moreover, in the literature, Gately and Huntington (2002), Cooper (2003), Dargay, Gately and Huntington (2007), Narayan and

Smyth (2007), Dargay and Gately (2010), argued that the determinants of oil consumption, are explained mainly by a positive relationship of income per capita and a negative relationship of its own price and when all prices are measured in US dollars which were found to be bias in their estimates by many researchers (see, Griffin and Schulman 2005; Fawcett and Price 2012). To begin our analysis, we previewed the data and observed that there is significant evidence that both the real U.S. price of oil and the U.S. real effective exchange rate contain a unit root and this has tremendous implications informing oil demand subsequent multivariate modeling and inference in net oil-importing countries in SSA. Therefore, we launched estimation methods gauged by empirical studies to assess the impact of US-Dollars exchange rate as a vehicle through which oil price movements are causing global demand shifts in net oil importing countries in SSA. To do so we estimate a parsimonious base line model of error correction model (VECM) on total oil demand, real GDP per capita, global real crude oil prices and the real exchange rate denominated in US dollar for a balanced panel of 28 countries in Sub Saharan Africa using a longitudinal contemporary time-series from 1980-2012. The application of a battery of econometrics techniques such as dynamic panel unit roots, cointegration, and dynamic Vector Error Correcting Mechanism (VECM) analysis yield consistent results and we found that in SSA, in the short-run, the US dollar exchange rate‘s elasticity of oil consumption is relatively greater compare to the elasticity of oil consumption vis-a-vis the variation of the crude oil price in US dollar. The rest of the paper is organized as follow: Section II the literature review documenting the empirical relationship between oil price and real exchange rate in the literature and the underlying theoretical foundations of oil demand’s determinants. Section III Description of Data and Variables. Section

model and Econometrics methods: Unit Roots and cointegration Section IV the empirical model and econometrics methods. Section V the empirical estimation methods and results. Section VI concludes.

II. Literature review

According to EIA, 2/3 of global energy demand is derived from crude oil and others refined petroleum products (US EIA, 2012). In 2005 the IMF in the regional economic outlook report that in the net importing-oil countries devising and implementing adequate policies to adjust to the variation of US-dollar exchange rate variation on the demand for oil is increasingly challenging while external and domestically terms of trade have been improving in all African countries exporting oil (p.1, 2005). However, the world is now sharing a slow oil demand, and rising supply which is likely to slow economic growth in many oil exporting countries but the uncertainty lingering around oil prices which is expected to rise again tend to depress current investment for government, firms and farm household in net oil importing countries. Moreover, up today, oil prices and exchange rate in net importing oil countries have both shared long-term volatility and the relationship between them still drive major research in the literature and this paper is not an exception. Figure 1 and 2 plots the means and levels of US dollars exchange rate and crude oil price in net oil-importing countries in Sub-Saharan Africa. Moreover, Breitenfellner and Crespo (2008) sketched a short contemporary history of crude oil prices and the US dollar exchange rate from 1950 to 2007 and show the degree of volatility and correlation of -.64 between the two variables (2008, p.104). Even though the literature is diverse especially in oil exporting countries,

the empirical literature keeps enough reasons why oil is billed in one single vehicle currency ($US) in the oil market around the world and that real exchange rates and real oil prices are cointegrated in the long and short run. Moreover, the subsequent variations on real oil prices have been identified as a credible explanation for non-stationarity of real exchange rates (Chaudhuri and Daniel, 1998). Moreover, Krugman (1983), McGuirk, 1983; Rogoff 1991; Camarer & Tamarit, 2002; Yousefi and Wirjanto, 2004; and Beckmann and Czudaj, 2012 found that in the literature focusing on developed economies, there is evidence that a depreciation/appreciation of the dollar triggers a decrease/increase in the price of oil. In the same vein, Rodrik (1999) focusing on developing economies found that net importing oil countries are directly influenced by exchange rate and real oil prices fluctuations. Nikbakht, (2000). Chen & Chen, (2007) found that there is a link between real oil prices and real exchange rates and that in a panel dynamic environment; the panel predictive regression estimates suggest that real oil prices might have forecasting power (p.1294, Dogan et al, 2012). Finally, Engle and Hamilton (1990), Zhou (1995) showed that the link between US dollars exchange rate swings and oil price is without a doubt a channel explaining business cycle and unemployment including various shock in the world economy. Following Hamilton (1990), Zhou (1995), Chaudhuri and Daniel (1998), Amano, and Norden (1998a) found that the non-stationarity features of the real crude price of oil explains to a large extend non-stationarity features of the US dollar real exchange rate and therefore the co-integrating vector as the long-run equilibrium exists between real price of oil and real US dollars exchange rate. As a result, we looked at the existing literature considering the theoretical foundations linking oil demand, GDP, oil prices and exchange rates especially in Sub-Saharan Africa. Sene (2012) in

estimating gasoline demand in developing countries used a linear and log linear model specified as function of gasoline consumption, total population, gasoline price, GDP, and the price index of public transportation in Senegal. Sene (2012) reviewed the literature from early 70's (Houthakker et al, 1974; Ramsey et al, 1975; Nordhaus, 1977) and show that the estimation of energy consumption started from on equation models to a complex dynamic approach in order to evaluate elasticities of the sectorial energy demand (p. 191). Researcher like Baltagi et al., 2002; Drollas, 1984; Griffin and Gregory, 1976;

Nordhaus, 1977), showed that pooled cross sectional time series displays less multicollinearity and that the local price of gasoline has a significant impact on demand in the short run (Sene, 2012, p. 191). Schryder & Peersman (2012) in studying oil demand for a specific country j departured from the ongoing literature from Dahl and Sterner 1991; Dahl 1993; Espey 1998; Gately and Huntington 2002; Cooper 2003; Griffin and Schulman 2005; Hughes et al.2008, Dargay and Gately (2010) and show that oil consumption is considered as a positive relationship of income and negative relationship of its own price (p. 5). However, Austvik (1987) examined the impact of US dollars exchange rate variations on the oil market in OECD countries using a partial equilibrium model to illuminate how the disequilibrium in the crude oil market is linked to the fluctuations of the dollar exchange rate (p. 399). Austvik Highlights that consumers in net oil-importing country j in SSA face a price in dollars multiply by each country j specific exchange rate against US dollars (p. 400). However, in the literature, study addressing the causal relationship running from exchange rates to oil prices and vice versa in net importing oil countries is relatively scarce. In the literature, we found that one strand discussed the causal relationship in OECD countries based on an asset-

pricing approach of exchange rate determination linking exchange rate to the discounted sum of futures fundamentals (Chen et al., 2008, cited in Beckmann and Czudaj, 2012, p. 5). Sadorsky (2000) used a cointegration analysis and found that futures prices for crude oil, unlead gasoline and the US dollars exchange rate have a long run relationship and the causal relationship is from the exchange rate to energy futures prices (Zhang, 2013, p. 342). Other likes Amano and Norden (1998a), Amano and Norden (1998b) Chen and Chen (2007) focused on the bilateral linkage using cointegration analysis in panel and multivariate time series. Zhang (2013) documents that in the literature, Lizardo and Mollick (2010) investigated US dollars exchange rate against major currencies in oil-importing/exporting countries and found that real oil prices lead to a significant depreciation of the US dollars against net oil exporting countries' major currencies (Canada, Russia, Mexico), p.342). Zhang (2013) argues that Hong (2002) as well as Zhang et al.(2008) studied the US exchange rate's volatility spillover effect on the price of oil exercising a cointegration ARCH-type models analysis, and the Granger causality to show that US dollar depreciation is behind the driving force of the international crude oil price swings" (2013, p.343). Beckmann and Czudaj, 2012 used a Markov-Switching vector error correction model to detect the causal relationship by showing that shocks in nominal exchange rates influence nominal oil prices (2012, P.1). Schryder & Peersman (2012) use US dollars exchange rate as a drivers of oil consumption in 23 OECD and 42 non-OECD oil importing countries beside those the SSA region and found that an appreciation of the US dollar exchange rate have a considerably larger effect on oil consumption than its own price shift when all prices are expressed in US dollars. However, Schryder & Peersman's finding did not includes net-oil importing countries in SSA where growth

and economic development concomitantly tied to energy demand seems to be the theme of the future when oil prices are expected to shore up in 2015 to force markets back into equilibrium

III. Description of Data and Variables

We use a balance panel longitudinal data (yearly frequency) to evaluate the extent to which US-dollar exchange rate is driving oil demand in net-importing oil countries of Sub-Saharan Africa. The data incorporate common effects (observed and unobserved) for 28 net oil-importing countries and we deployed advance techniques in panel data estimation to exploit heterogeneity of the coefficients, unit root behavior and cross-country dependence in the space of fixed and floating regime exchange rate in Sub-Saharan Africa. All variables are converted into natural logarithms, so that the models specification frame the behavioral description of the observation mechanism and yield a constant elasticity form. The countries are Cape Verde, Central African Republic, Cote d'Ivoire (Ivory Coast), Benin, Burkina Faso, Guinea, Guinea-Bissau, Mali, Niger, Senegal, Togo, Comoros, Ethiopia, Gambia, The, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mauritania, Mozambique, Rwanda, Sierra Leone, Tanzania, Uganda, Zambia, Zimbabwe. The data covers the period of 32 years (1980 - 2012) and are from International Energy Agency (IEA), the International Financial Statistics (IFS), World Bank Development Indicator (WDI), and the United States Department of Agriculture (USDA). The variables are defined as follow:

Total import of refined oil [TIMP] is measure in 1000 barrels per day and from the International energy agency (IEA). The Consumer prices [CPI] (indices, 2005=100) are from the International Financial statistics (IFS). The Global real Crude oil price [GRCOIL] is the average U.S. Dollars per Barrel (Nominal Dollars) or Refiner acquisition cost of imported crude oil into net-imported

oil countries and from the International energy agency (IEA). The individual nominal exchange rates [NOEX] in country j in the panel is the national currency unit to US$, period average) and are from the International Financial Statistics (IFS). The real effective exchange rate [REEX] is the Individual nominal exchange rates in country j in the panel (national currency unit to $ US). The Real gross domestic product Per Capita [RGDP] is measured 2005 constant prices and the Real US dollar effective exchange rate [RUSEX] is based on the consumer price index and are from the world development Indicator (WDI) and the United States department of agriculture (USDA). The total oil consumption or total oil Demand is expressed in (1000 barrels/ day) and from international energy agency (IEA). We also calculate the total oil demand per capita [TOILD] as the ratio of Total oil demand per capita (1000 barrels per day, per 1000 persons) in country j in the panel and total population measure midyear population in country j in the panel multiply by 1000 and also from WDI. Most importantly the real international crude oil price [GRCOIL] is expressed as the ratio of the international nominal crude oil price and the consumer price index multiply by 100. The real exchanges rates [REEX] is adjusted by the ratio of the exchange rate of net-oil importing country times the price level [CPI] of US or foreign country divided by the domestic price [CPI] of net-oil importer country j in the panel

IV. The Empirical Model and Econometrics Methods

In the empirical literature, the link between the crude oil price cycle vis-a-vis the dollar cycle is apparent in this paper (see, Fig1-2). However, the underlying causes are an ongoing debate in the empirical literature. Therefore a more thorough analysis of the crude oil market volatility and its drivers is always vital. Mundell (2002) warned against two common mistakes in studying

causal relationship between crude oil prices and US dollars exchange rate. One mistake is to assume that US dollars exchange rates do not matter or is a weak driver, while the other mistake is to accuse vehemently US dollars exchange rates as solely responsible for all the variation in the oil market and hence oil consumption especially in net oil-importing countries. Mundell argues that both crude oil prices and US dollars exchange rate do matter in the short run, while in the long run their impact is less important to some extent at least for developed countries. Therefore, the underlying drivers and shift of oil consumption in net-oil importing countries is contentious as the impact of US dollars exchange rate and crude oil prices might not be mutually exclusive over time. Therefore Breitenfellner and Crespo (2008) show that "economic theory highlight that the link might be either positive or negative or may change intertemporarily" (p.107). Consequently, Cheng (2008) in the World Economic Outlook, IMF (2008) identified a number of channel trough which US dollars exchange rate can shift commodity prices such as crude oil via different identified channel in the empirical literature. Breitenfellner and Cuaresma (2008) argue that the purchasing power and cost channel, the local price channel, or the investment (asset) channel, or the monetary policy channel, and/or the currency market channel are identified as channel within which the U.S. dollar and crude oil price have a negative relationship. While each on these channels is a transactional function to be investigated empirically, the local price channel and purchasing power and cost channel is most relevant for this paper since any change in the US dollars exchange rate can alters the terms of trade between any two countries j in SSA and the world oil market. From this perspective, Schulmeister (2000) argued that within the purchasing power and cost channel the impact of such change depend relatively " on the proportion of the

dollars goods (crude oil) relative to the non-U.S dollars countries, which arise from asymmetries between countries, (see also, Krugman 1984). However, in the empirical literature it is also apparent that the scale and magnitude of these shifts and variations depend on the difference in the theoretical foundation, methods of estimation, and data availability and temporal restriction (Amano and Van Norden, 1998; Benassy, Q et al, 2005; Krichen, 2005; Yousefi and Wirjanto, 2004, 2005). Austvik (1987) demonstrates that the fluctuations in the exchange rate of the U.S. dollar are a source of disequilibria (Breitenfellner and Cuaresma, P.111). For example, when the U.S. dollar depreciates consumers in the net-oil importing countries for instance face cheaper prices in their domestic currencies, which in turn increase the demand for oil and drive adjustments in the oil price denominated in U.S. dollars SSA. Since, cointegration relationship is identified, we specified a model, which include the residuals from the vectors (lagged) in a dynamic Vector Error Correcting Mechanism (VECM). Moreover, given that we used the Global real crude oil price [GRCOIL] and real US dollars effective exchange rate [RUSEX] rather than the bilateral exchange rate, which suffers from endogeneity, this paper follows, Gately & Huntington (2002) and Griffin & Schulman (2005), and De Schryder, Selien & Peersman, Gert (2013) to estimate a parsimonious base line model following the specification of an error correction model for country j at time t expressed as:

$$Oildem_{it} = f(gdp_{it}, oilp_t, reer_t, trend_{t,}, C_I) \qquad \textbf{[1]}$$

In the estimation, each variable is the natural log of $Oildem_{it}$ which is the total real oil consumption in each country in the panel, the natural log of gdp_{it} which is country's derived

energy from oil in the formation and accumulation of capital, machinery, household equipment, vehicles, and farm technology adoptions in each country in SSA, the natural log of $oilp_t$ which is the world real U.S dollar crude oil price (Brent), even though consumers in net-oil importing countries use domestic (local) currency to buy oil. However, unlike many paper using local price expressed in domestic currency in their estimation, this paper uses $oilp_t$ because this will allows us to identify changes cause by the global crude price of oil and the US dollar exchange rate in the model in equation [1]. Therefore, we track the changes by including the natural log of $reer_t$ which is the real effective U.S dollar exchange rate, and a time trend $trend_{t,}$ and country specific characteristics in the model. The country specific characteristic of each economy archetype, common factors and prices substitutes a constant term C_I and time trend $trend_{t,}$. However, following Griffin and Schulman (2005) showed when they include price substitutes of crude oil in their model it did not alter neither improves their estimates (see also, De Schryder, Selien & Peersman, Gert, 2014). Therefore, equation [1] will be estimated in this study using a Vector Error Correction Model in panel given the prior evidence of cointegrated I (1) variables, which we analyses and tested in the following section.

1.1 Econometrics Methods: Panel Unit Root Tests, Cointegration and VECM.

In this section we have reviewed critical aspects of known population distribution of random variables in time series, which have fundamental considerations and implications for equilibrium analysis and forecasting. To do so we performed 4 tests to check for covariance stationarity and invertibility on individual series. Therefore, in the time series literature, limiting distributions are complex functional series of Weiner processes. Thus in this paper since the data are both heterogeneous and non-stationary with the panel structure, we performed the Levin–Lin–Chu (2002), Breitung (2000), Im, Pesaran and Shin (2003) and the augmented dickey fuller tests to combine individual unit root tests. The cointegration tests are adapted from Pedroni (1997a), which is very useful in deriving the asymptotic distributions and tests each sample performances and efficiency for the seven (11) tests statistics. Moreover, this is important to note that Pedroni (2000) used in this paper consider the same issues we tackled in combining unit root tests such as considerable heterogeneity and nonstationary classified into two categories. The first test in Pedroni average the tests statistics for cointegration in the time series across cross-sections and the second average one stepwise testing so that the limiting distributions are based on limits of piecewise numerator and denominator index (see, Phillips and Ouliaris, 1990). We also evaluate the robustness of our findings in Pedroni by using Kao Residual cointegration, which is based on Engel Granger Based test and strong exogeneity of the regressors and errors dickey Fuller DF_{ρ}^{*} and DF_{t}^{*} are for the cointegration with endogenous relationship between regressors and errors. After testing for stationary on each variables applying the LLC, IPS, Breitung, Hadri and Dickey-Fuller distribution we obtain information in the independent cross-section in the panel which point out to a stronger overall signal than the pure or individual time series case. Consequently the

existence of unit root could not be rejected for all the variables for both at constant and linear trend model. After first differencing, we performed the tests of unit root at the first difference level and all the variable are I (1) and as consequently, we get the warrant to carry the cointegration tests since there is no I (2) and that the pooled test rejects the null hypothesis of no cointegration or no error correction between the variables $Oildem_{it}, reer_t;\ gdp_{it}$ and $oilp_t$. Following these results, the logical relationship found in this paper warrants the implementation of the panel error correction model (ECM)[2] specify as follow:

$$\Delta OilDem_t = \theta_0 + \ \theta_i * trend + \delta_i * OilDem_{i,t-1} + \delta_i^l * gdp_{i,t-1} + \beta_i^l * roilp_{t-1} \ + \tau_i^l * reer_{t-1} + \gamma_i * \Delta gdp_{i,t} + \lambda_i * \Delta roilp_t + \tau_i * reer_{t-1} + \varepsilon_{i,t} \qquad \textbf{[2]}$$

V. The Empirical Estimation Methods and Results

Our estimation takes into consideration different aspects of net-oil importing countries in SSA. Heterogeneous countries with different economic and institutional framework characterize Sub Saharan African's countries. Hence, in this paper there are a large number of homogeneous countries within the West African Monetary Union (WAEMU), the Central African Economic and Monetary Community (CEMAC), and the East African Community (EAC)'s exchange rate arrangements both common to freely floating exchange rates (see, fig: 1,2). To evaluate the

[2] De Schryder, Selien & Peersman, Gert, (2014) was very helpful in the application and specification of the ECM where the authors empirically applied it in the OECD and Non-OECD countries importing oil and exporting oil in Europe, South America, South East Asia etc. the authors also indicate that Huntington(2002) and Griffin and Schulman (2005) used the same approach which was related to their study for a panel of multiple countries and moderate time dimension.

robustness of our results we evaluate the Pooled Mean Group (PMG) estimator, which considers the short-term parameters to differ between groups under the restriction of equal long-term coefficients between groups in the panel. In addition, PMG assumes common long-run coefficients while letting the short run dynamics and error-correction coefficients across countries to be different. Therefore in the short run the estimated coefficients indicate the intertemporal relationship between US-dollars exchange rate, oil price and oil consumption in response to exogenous shock (see, Jansen, 1998). Therefore, when we estimate the fixed effect coefficients and compare it the results in PMG we are able to better assess the long-run coefficient that reflects the impact of US dollars exchange rate on oil consumption via crude oil price. Of the advantage of the PMG estimation in this study is that, PMG assuming homogeneity of the individual cointegrating vector across countries. Moreover, PMG pools long run relationships between countries and the short run dynamics are unrestricted across panels (see, Pesaran et al. 1999). We also compare our results with Pedroni (2000)'s group mean fully modified ordinary least square technique (GM-FMOLS) which allows for heterogeneity in the cointegrating vector in panel and does capture the characteristics and specificity of the countries in the panel. Contrary to De Schryder & Peersman, (2014) instead of using the Mean Group estimation approach we use the PMG because the MG is less restrictive compare to the PMG estimator. In fact, we observed that the PMG estimator is consistent and more efficient under the assumption of common long run coefficient parameters (see, Das, 2011). As a result, we safely argue that our estimates are unbiased, less restrictive relative to country specific effect and fixed effects. Since PMG involves both pooling and averaging, it can be considered as an intermediate estimator between dynamic

fixed effect (DFE) and the group mean Fully modified least square (GM-FMOLS). Table 4 Report the results.

1.2 Testing For US Dollars Exchange Rate Pass Through to Gasoline Prices in SSA

VI. Conclusion:

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Figure1: Mean of Crude oil price and US dollars Exchange rate from 1980-2012

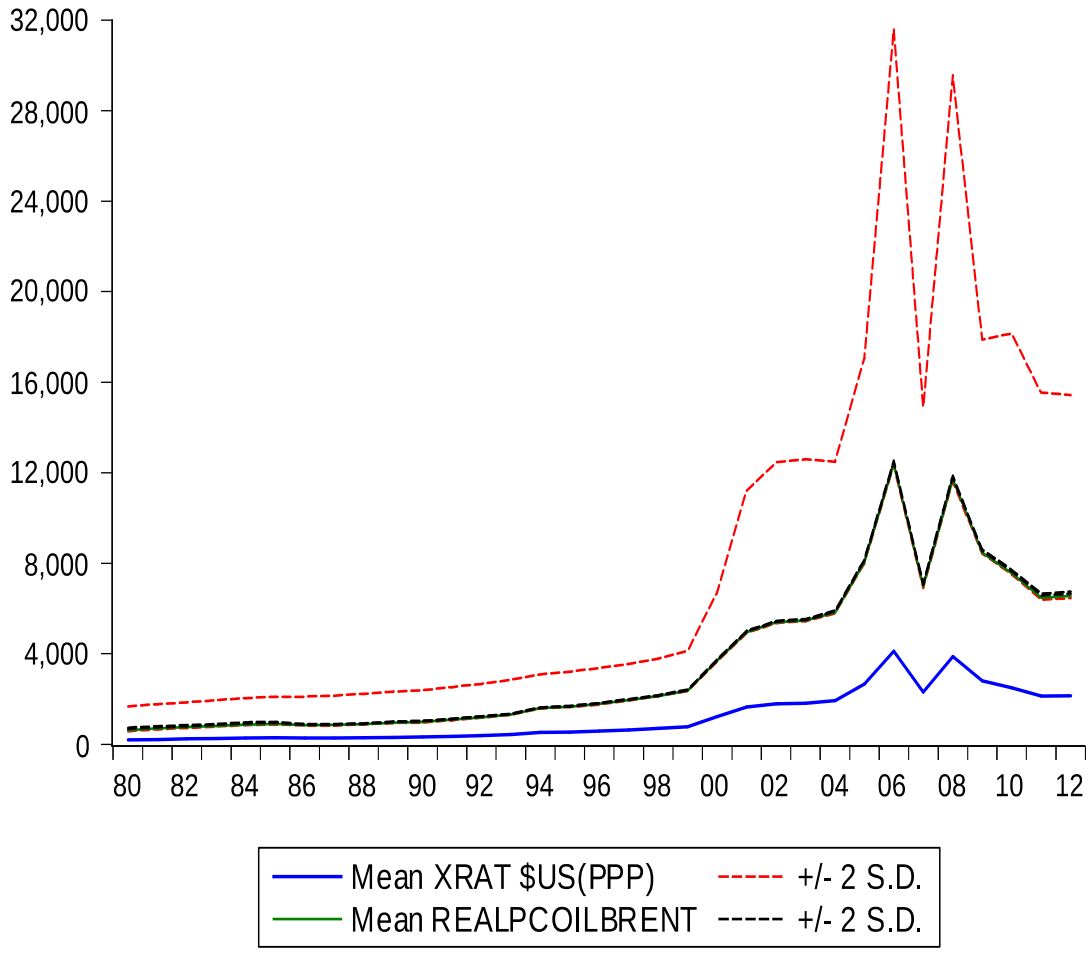

Figure2: Individual Country in Panel: Crude oil price and US dollars Exchange rate 1980-2012

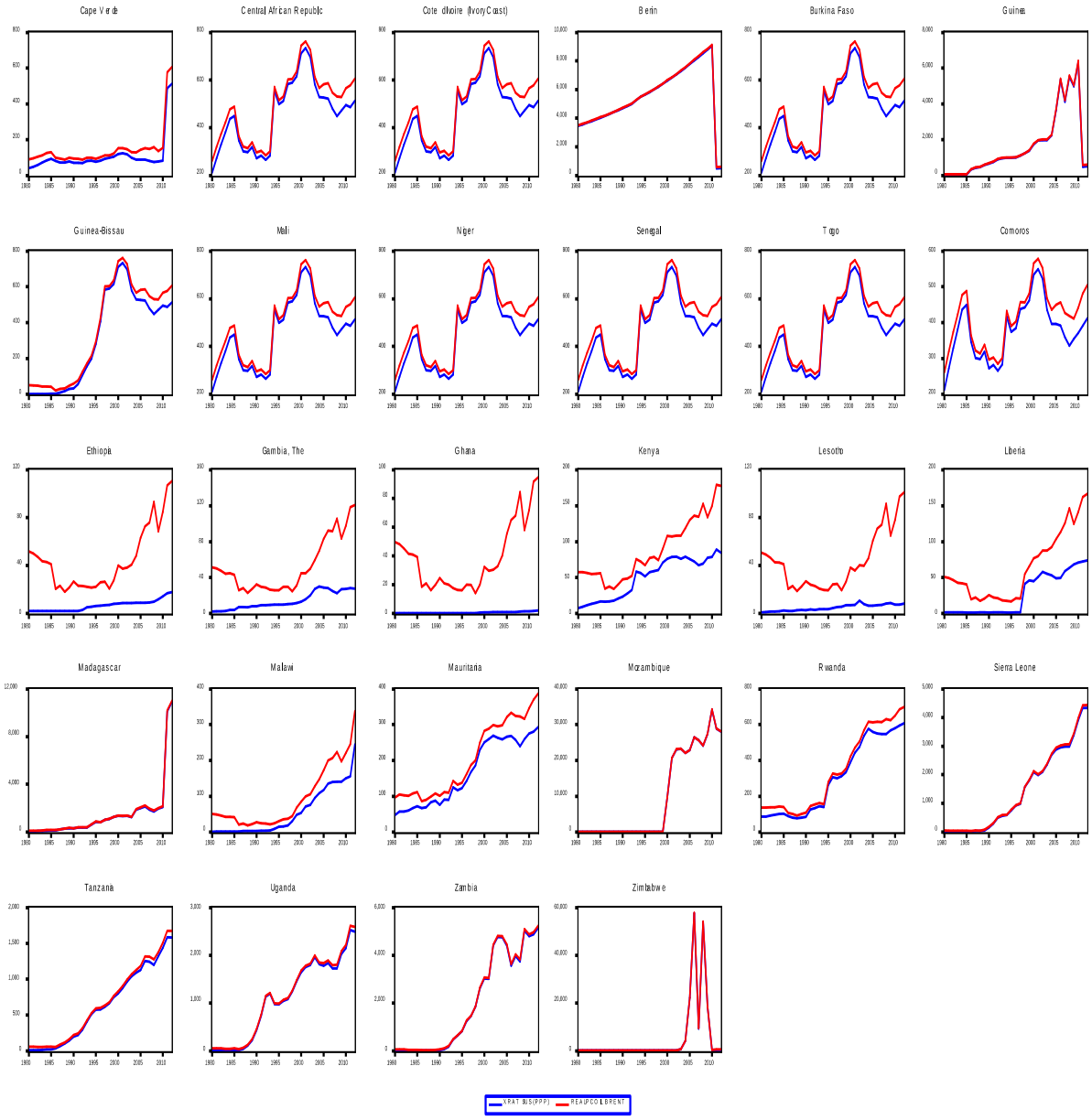
Cape Verde
Central African Republic
Cote d'Ivoire (Ivory Coast)
Benin
Burkina Faso
Guinea
Guinea-Bissau
Mali
Niger
Senegal
Togo
Comoros
Ethiopia
Gambia, The
Ghana
Kenya
Lesotho
Liberia
Madagascar
Malawi
Mauritania
Mozambique
Rwanda
Sierra Leone
Tanzania
Uganda
Zambia
Zimbabwe
XRAT BUS(PPP)
REAIPCOLBRENT

Table 1: Descriptive statistics: Panel Variation for the dependent variable and regressors within and between variation

Variable		Mean	Std. Dev.	Min	Max	Observations	
OilDem	**Overall**	11.82762	13.08853	0.25619	81.44677	N =	924
	Between		3.317895	8.228571	19.5567	n =	33
	Within		12.67372	-6.678105	74.74905	T =	28
Roilpt	**Overall**	38.37394	22.60014	13.66	92.82	N =	924
	Between		22.93813	13.66	92.82	n =	33
	Within		1.31E-14	38.37394	38.37394	T =	28
RGDP	**Overall**	642.9116	415.7475	73.73539	3365.663	N =	924
	Between		62.81803	559.8194	799.6912	n =	33
	Within		411.1147	127.3995	3272.053	T =	28
XRATUS~P	**Overall**	1177.176	4178.364	0.0002749	57753.76	N =	924
	Between		1117.56	193.138	4110.452	n =	33
	Within		4030.672	-2932.36	54820.49	T =	28

Notes: Overall variation: variation over time and individuals variables. Between variation: variation between individual's variables. Within variation: variation within individual's variables (over time). The overall variation can also be decomposed into between variation and within variation. Here what is essential is that the between or within variation is larger for each variable. Because, fixed effects models might work much better if there are many variations within each country variability for each variable or conversely fixed effects estimation might not give interesting results if there is little variation.

Table 2: Panel Unit Root Tests

Variables	Tests	LLC	Breitung	IPS	ADF-Fisher Chi-square
	(L)	3.5888	6.8969	6.43506	28.37
OilDem		(-0.9998)	(1.0000)	(-1.0000)	(-1.0000)
	(D)	-15.8322	-2.32969	-14.55	-13.4355
		(0.0000)**	0.0099	(0.0000)**	(0.0000)**
	(L)	6.77535	9.45805	6.46195	5.81388
RGDP		(1.0000)	(1.0000)	(-1.0000)	(1.0000)
	(D)	-7.78541	-6.70146	-11.0319	-10.5918
		(0.0000)**	(0.0000)**	(0.0000)**	(0.0000)**
	(L)	10.6501	9.70244	7.6117	8.11533
ROIP		(1.0000)	(1.0000)	(1.0000)	(1.0000)
	(D)	-10.3931	-14.0403	-20.8823	-17.5141
		(0.0000)**	(0.0000)**	(0.0000)**	(0.0000)**
	(L)	193,976	3.14172	5.96998	5.52691
XTRATUS		0.9738	(1.0000)	(1.0000)	(1.0000)
	(D)	-5.58949	-2.04847	-14.6572	-11.2154
		(0.0000)**	0.0203	(0.0000)**	(0.0000)**

Notes: ** Indicates the rejection of the null hypothesis of non-stationary at the 1% level of significance. Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality and Stationary Null hypothesis (common unit root process) at the 5% level of significance and Newey-West automatic bandwidth selection & Bartlett kernel. Probabilities are computed assuming Asymptotic Normality with a left hand side rejection area, except on the Hadri test, which is right sided and are in Parentheses. Variables are in logarithm. (L) Indicates at level and (D) indicates Difference. LLC=Levin, Lin, Chu (2002), (LLC, Breitung, IPS) or stationary (Hadri). Number of observations (502).

Table 3: Series: XRAT- RGDP- RPOIL- OILDEM-H_0: No Cointegration

Pedroni Residual Cointegration Test

H_A: Common AR Coefs. (Within-dimension)

			Weighted				Weighted	
	Statistic	**Prob.**	**Statistic**	**Prob.**	**Statistic**	**Prob.**	**Statistic**	**Prob.**
Panel v-Statistic	5.49	0.00**	-0.07	0.53	1.09	0.14	1.89	0.03**
Panel rho-Statistic	-8.61	0.00**	0.02	0.51	-5.67	0.00**	2.09	0.98
Panel PP-Statistic	-11.13	0.00**	-1.20	0.12	-10.03	0.00**	0.78	0.78
Panel ADF-Statistic	-11.78	0.00**	-1.74	0.04**	-10.94	0.00**	-0.14	0.45

H_A: Individual AR Coefs. (Between-dimension)

	Statistic	Prob.	Statistic	Prob.
Group rho-Statistic	1.44	0.93	3.91	1.00
Group PP-Statistic	-0.26	0.40	1.98	0.98
Group ADF-Statistic	-2.57	0.01**	-0.18	0.43

Pedroni Residual Cointegration Test

H_A: Common AR Coefs. (Within-dimension)

			Weighted	
	Statistic	**Prob.**	**Statistic**	**Prob.**
Panel v-Statistic	4.00	0.00**	0.53	0.30
Panel rho-Statistic	-6.01	0.00**	-0.40	0.34
Panel PP-Statistic	-7.03	0.00**	-1.45	0.07
Panel ADF-Statistic	-6.00	0.00**	-2.26	0.01**

H_A: individual AR Coefs. (Between-dimension)

	Statistic	**Prob.**
Group rho-Statistic	1.05	0.85
Group PP-Statistic	-0.98	0.16

Kao Residual Cointegration Test

ADF

t-Statistic	**Prob.**
4.94	0.00**

Group ADF-Statistic	-3.41	0.00**

Notes: ** significance level 5%. We performed the test on Individual Intercept, Individual Intercept and Individual Trend; nor Intercept or trend. In each test we have 11 statistic except KAO and the null is rejected statistics are standardized such that all reported values in this table are distributed as Normal under the null hypothesis of no cointegration

Table 4: Empirical Results Estimates:

Variables	**Fixed Effect**	**(PMG)**	**(GM-FMOLS)**
LRGDP	0.4281	0.423756	0.414272
	(0.0000)**	(0.0010)**	(0.0021)**
LROIP	-0.048784	-0.043572	-0.450594
	(0.0000)**	(0.0000)**	(0.0000)**
LXTRATUS	-0.051134	-0.053844	-0.0566221
	(0.0000)**	(0.0000)**	(0.0000)**
Trend (Time)	-0.0002	-0.0003	-0.0001
	(0.0001)**	(0.0003)**	(0.0000)**
	Long Run Coefficients VECM Estimates		
LOilDem	1.0000	1.0000	1.0000
LRGDP			
LROIP			
LXTRATUS			
Trend (Time)			

FE: Fixed Effect

GM-FMOLS: Group Mean Fully Modified Ordinary Least Square

(PMG): Pool Mean Group