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Drilling deeper: Understanding Trade in Angola

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Abstract

The present study analyzes Angola's trading partners from 2005 to 2015 in order to understand the main drivers of Exports and Imports growth. Departing from a gravity model, foreign GDP growth and real exchange rate fluctuations were interpreted as demand and supply disturbances on Exports. While nominal and real exports both increase with demand expansions, they react differently to supply shocks. Imports are growing at the same rate as Angola's economy while exchange rate fluctuations capture the wealth effect of Oil price in the economy.

Keywords: Gravity Model; Angola; Oil Price; Exports.

1. Introduction

Angola attained its independence in 1975 but descended into a brutal and costly civil war in the following years. Decades of hostilities ended in 2002 with considerable deficits in infrastructure and human capital. Although possessing a natural resource base that could support an extensive range of economic activities, Angola is deeply dependent on the production of oil, a capital-intensive sector. Since the end of the war, the combination of increased production and record prices for oil has spurred unprecedented economic growth. Supported by oil revenues, this rapid growth also extended Angola's dependence on mineral revenues, making the country more vulnerable to global commodity market swings. The combination of its significant oil wealth and infrastructure gaps raises the concern for

government mismanagement of resources and the possibility of ineffectual, unstable and corrupt institutions.

Angola's exports are driven by fluctuations on oil prices as mineral fuels contributed for more than 95 percent of exports revenues. Accounting for over 45 percent of GDP, the oil sector has not only promoted Angola's recent strong economic growth but has also been the main source of tax receipts. For that reason, mineral revenues are decisive to conduct fiscal policy and managing the country's public finances. Channeled through exports and constraining government budgetary policy, oil price shocks have a critical impact on domestic demand. Thus, deviations in this commodity market have widespread effects on the overall economy.

The monetary authority is also constrained by fluctuations in the oil market. Angola Central Bank (BNA) maintains a fixed exchange rate by managing foreign reserves. Current account surplus/deficits increase/decrease the level of those reserves. The use of foreign country's currency (the dollar) as sound currency for conducting transactions allowed hedging against inflation and FX risks and provided a vehicle for domestic investment as alternative to capital flight. The value of the dollar offers a greater stability but at the expense of effectiveness in monetary transmission mechanism and seigniorage.

While capturing the price and production upturn, exports revenues arising from the natural resource increased domestic demand, triggering a rise of non-tradable goods' price, which led to an appreciation of the real exchange rate. Due to the implied real exchange rate appreciation, non-oil exports sectors became less competitive and the potential for expanding and diversifying trade was absorbed by the shift in domestic resources from those sectors to the nontraded goods sectors. The recent decline in oil prices is expected to adversely impact the country's economic growth. The period of macroeconomic overheating is now being followed by a phase of financial pressure, calling for adjustment effects on the real side of the economy that might not be achieved over the short term.

The sharp fall in oil prices rose concerning liquidity and solvency problems. Angola faces growing macroeconomic instability since the industrial, construction and services sectors are adjusting to the fall in private consumption and public investment, in addition to persistent difficulties to obtain foreign currency. The vital role played by changes of international oil prices motivates the research of this paper: explore the relationship between Angola and its major trading partners.

The price of oil is determined by *(i)* the current supply, *(ii)* the access to future supply subject to the amount of oil reserves and *(iii)* the world demand for the commodity. The supply is dependent on geological discovery, extraction costs, the availability and cost of technology and the political situation in oil-producing countries. Historically, supply has been controlled by oil producers and is the main driver of commodity price volatility. Although being Africa's second largest producer and a member of OPEC since 2007, Angola has no scale to influence oil price. On the other hand, the demand relies on global macroeconomic conditions and increasing dependence on fossil fuels for energy. A detailed analysis of the relationship between Angola and its major trading partners can provide a better understanding of oil demand in Angola which, in light of the exogenous supply shocks, can be a powerful tool to conduct policy.

Exports are held by a small number of countries. Since 2005, 80% to 98% of the total share of exports has been held by Angola's ten major importers¹. The USA was formally the major importer but China has gradually gained a relevant part of its market share, receiving today close to 50% of merchandise exports. Historical trade figures² show a significant fall on nominal exports at 2008 with revenues cut in almost half in less than a year. Still, the number of barrels sold increased during that same time. There is a very close relationship between

¹ China, United States of America, India, Taiwan, France, South Africa, Spain, Canada, Portugal and Netherlands in the first quarter of 2014

² Figure 1, 2 and 3 in Appendix

nominal exports and crude oil price, with exports “reacting” to oil shocks one or two quarters after the shock³.

Regarding Imports, Angola has a more diversified trading share composition, with Portugal, the US and China as the main importers (which together have had a share between 20% and 60% of imports revenues) but with some other major players such as Brazil, South Africa, France and South Korea. The 10 major importers have had a share between 63% and 74% of the total imports, but if one accounts for the 15 major importers those shares change to 76% and 91%. Imports are mainly machinery and metal equipment, vehicles and transport materials, and food.

As previously used in international economics since the work of Jan Tinbergen [1962], a Gravity model was proposed contrasting to former applications of this methodology in the following way: *i)* study a single country relationship with its major trading partners instead of the usual “two-sided” model; *ii)* test for the stationarity of the variables in the data to produce valid inference; *iii)* extend the model for growth variables and derive a positive relationship between foreign growth and exports growth, while controlling for real exchange rate fluctuations; *iv)* use real exports growth as a proxy of real GDP growth in Angola and derive a positive relationship with real imports growth.

The remaining of the paper is organized as follows: section 2 provides a theoretical framework; section 3 describes the methodology pursued and the main concerns that might arise from it; section 4 presents the data used; section 5 describes the empirical results and section 6 concludes.

³ Crude Oil is mostly traded through futures contract and, as such, it is reasonable for exports to react after the price shock.

2. Theoretical Framework

A theory of free trade traces back to the XVIII century marked by the publication of Adam Smith's *Wealth of Nations* [1776]. Smith determined that countries should specialize in the production of goods that have absolute advantage and gain from trading with each other. David Ricardo complemented Smith's hypothesis stating that comparative and not absolute advantages are necessary, as well as sufficient, to guarantee mutually gainful trade across nations. If a particular good can be produce at a lower relative opportunity cost than a nation should export that good, importing those in which it has the least comparative advantage. Later, the Heckscher-Ohlin (H-O) model introduced patterns of commerce and production based on the factor endowments of a trading region such that countries export products that use their abundant and cheapest factors of production and import products that use the countries' scarce factors. Nonetheless, these models are unable to explain the huge proportion of trade between nations with similar factor of endowments as well as intra-industrial trade, which dominates trade of developed economies. The rigid framework of trade theory motivated different identification schemes which describe world trade based on the economies of scale, imperfect competition and product differentiation.

Jan Tinbergen [1962] tried to explain volume of trade by establishing a baseline for bilateral trade flows determined by the size and proximity of any two countries. By analogy with the Newtonian theory of gravitation, this empirical framework was denoted as "gravity equation" model. This model is extremely popular for applied trade analysis. Stable and powerful, it lacks a theoretical explanation but has been used intensively in analyzing patterns and performances of international trade in recent years. It has been criticized for being ad hoc⁴ and several authors have tried to exploit this class of models by providing a theoretical basis.

⁴ "is therefore not evidence of anything, but just a fact of life" Deardorff [1998]

Without theoretical foundations “one cannot conduct comparative statics exercises, even though this is generally the purpose of estimating gravity equations.”⁵

In 1979, James Anderson was the first to propose a theoretical explanation of the gravity equation based on a demand function with Constant Elasticity of Substitution (CES) à la Armington [1969], where each country produces and sells unique goods on the international market. The model assumes that all goods are tradable and every country is trading. Therefore, the sum of home and foreign demand for each good (different from those produced in every other country) will be, in equilibrium, the national income of the country.

Later work has included the Armington structure of consumer preferences in monopolistic competition frameworks where identical countries trade differentiated goods because consumers have a preference for variety (Krugman 1980; Bergstrand 1985, 1989). Models based on Ricardian theory were first proposed by Eaton and Kortum [2002] and models build on traditional factor-proportions explanation of trade, i.e., à la Heckscher-Ohlin where led by Deardorff [1998]. Evenett and Keller [1998] showed later than the standard gravity equation can be obtained from the H-O model with both perfect and imperfect product specialization.

Anderson and van Wincoop [2003] included a “multilateral trade-resistance” (MTR) term that intends to model the impact of multilateral factors on bilateral trade flows since the omission of such term can jeopardize a well specified model thus, the validity of the results. A more recent wave of theoretical work such as international trade in differentiated goods with firm heterogeneity were spearheaded by Helpman et al. [2008] and Chaney [2008].

In its general formulation, the gravity equation can be denoted as:

$$X_{ij} = A \frac{Y_i Y_j}{\phi_{ij}}$$

⁵ Anderson and van Wincoop [2003]

Where:

X_{ij} is the monetary value of exports from region i to j

Y_i comprises exporter-specific factors that represents the total amount exporters are willing to supply

Y_j comprises importer-specific factors that represents the total importer's demand

ϕ_{ij} represents the ease of exporter i to access of market j

A is a variable that does not depend on i or j such as the level of world liberalization

Recent empirical trade literature (Cheng and Wall, 2005; Baldwin and Taglioni, 2006) verified that the results of gravity models may be relatively sensitive to the proper specification. In particular, the cross-sectional and time dimension should be used in order to get more reliable coefficient estimates. Ignoring heterogeneity leads to biased estimates of bilateral trade relationships. Furthermore, if the firm decision to export at a given year is established based on its past decisions, one should consider the process as autoregressive and so include the time dimension. As pointed by Helpman et al. [2008] countries that traded yesterday tend to trade today, i.e., there is strong persistence in aggregate trade data.

While these authors recommend panel data models, other issues may arise to possible non-stationarity of analyzed data. The spurious relation problem is less important in panels than in time series analysis but it can still lead to biased results (Kao and Chiand, 2000). The standard estimators of gravity models do not consider possible endogeneity between trade and output. Nevertheless, panel cointegration can be used for a more complete and robust estimate of the model.

Following the reasoning of the gravity model and working with differentiated variables, one expects foreign GDP growth to increase exports growth⁶. "Higher foreign income means higher foreign demand for all goods, both foreign and domestic. So, higher foreign income leads to higher exports."⁷ Economic theory also acknowledges that the exchange rate plays a key role in a country's trade performance, reflecting the price of domestic goods in terms of

⁶ The model does not infer this result. A country might have small GDP and be growing substantially (or might have a large GDP and low growth). Still, if the growth path is consistent over time, the small country will eventually become "larger" and the result might be valid.

⁷ Blanchard, *Macroeconomics*

foreign goods. Therefore, exports respond to changes in the real exchange rate and not the nominal one. “A country’s products become cheaper to foreigners only when that country’s currency depreciates in real terms”⁸. The relative valuations of currencies have important repercussions either determined by exogenous shocks or by policy. A weaker domestic currency stimulates exports and makes imports more expensive. Conversely, a strong domestic currency hampers exports and makes imports cheaper. Omitting the exchange rate might provide biased results on the gravity model.

On the other hand, growth of Imports should also be driven by exchange rate fluctuations, but is expected to move in the same path as the domestic economy. Similar to previous reasoning, “higher domestic income leads to a higher domestic demand for all goods”, therefore increasing Imports.

$$\Delta X_{jt} = f(\Delta Y_{jt}, \Delta ER_{jt}, \mu_{k,jt})$$

$$\Delta IM_{jt} = f(\Delta Y_t^i, \Delta ER_{jt}, \mu_{k,jt})$$

Where ΔX_{jt} is exports growth to country j at time t ; ΔY_{jt} is GDP growth of country j at time t ; ΔER_{jt} is Exchange rate variation with country j at time t ; ΔIM_{jt} is imports growth from country j at time t ; ΔY_t^i is Angola’s GDP growth at time t ; and $\mu_{k,jt}$ are k other parameters that influence trade.

3. Methodology

A panel framework is designed to cover trade variation between Angola and thirty-six trading partners during a period of ten years. Panel estimation can capture dynamic relationships and might control for country heterogeneity, offering more variability, more degrees of freedom and reducing collinearity among explanatory variables, therefore improving the efficiency of the econometric estimates. Because T (Time) is almost of the same order as N (Country) an

⁸ Krugman and Wells, *Macroeconomics*

“asymptotic analysis that makes explicit assumptions about the nature of the time series dependence is needed”⁹. It might be the case that the conclusions regarding consistency and efficiency are not valid, thus discrediting the results.

Gravity models are usually applied in the literature by not specifying a region as an object of study but instead evaluating the reciprocal relationship of every region in the sample. Although losing some of its properties, the framework will only include a single country relationship with its major trading partners over time.

By taking the natural logarithms of all variables and obtaining a log-linear equation that can be estimated by OLS regression, one is accounting for the multiplicative nature of the gravity equation. This yields the estimation equation:

$$\ln X_{jt} = \ln A + \ln Y_{jt} + \ln \phi_{jt}$$

Where:

X_{jt} is the monetary value of trade to country j at time t

Y_{jt} is country j size at time t

ϕ_{jt} represents the ease of country j to access Angola's market at time t

A is a variable that does not depend on i or j

In order to apply the correct framework and have consistent estimates and valid inference, a test on the stationarity of the variables is needed. The panel unit root tests should be in accordance with the sample, reflecting if the panel is balanced or unbalanced and assuming a fixed N whereas T tends to infinity¹⁰. The rejection of the null hypothesis means that at least one of the series j is stationary. Thus, it is possible only one or two series j are stationary and still reject the null hypothesis of all series being non-stationary. Therefore, “the results of a panel unit root test may be dependent on the choice of the time-series variables included in

⁹ Wooldridge, *Econometrics Analysis of Cross Section and Panel Data*

¹⁰ Typically assumed in macroeconomic analysis and reflecting the actual sample of this work (N=36; T=42)

the panel”¹¹. Since the panel is unbalanced, the Im, Pesaran and Shin test, Maddala and Wu test and Pesaran's CADF test were performed.

The variables in the level form are not of the same order of cointegration but their growth rates guarantees stationarity. Thus, the relationship between trade and GDP is measured by a panel gravity model that follows a growth specification. A positive relationship between foreign growth and national exports growth is expected. The change in exchange rates will be included to control for the ease of each country to access Angola’s market this is, the real cost of importing from Angola. Other variables can also be considered such as distance and a dummy for oil producers. More formally, the estimation of the effect on is based on the following specification:

$$\Delta X_{jt} = \beta_0 + \beta_1 \Delta Y_{jt} + \beta_2 \Delta \phi_{jt} + \sum_{k=3}^n \beta_k \mu_{k,jt}$$

For imports, the specification will be similar but, as theory predicts, one should use the growth of the country as the independent variable instead of the foreign growth. A growing country is expected to import more, controlling for the exchange rate and for other possible variables:

$$\Delta IM_{jt} = \beta_0 + \beta_1 \Delta Y_t + \beta_2 \Delta \phi_{jt} + \sum_{k=3}^n \beta_k \mu_{k,jt}$$

Afterwards, one needs the panel data model that best fits the data: Pooled estimation, Fixed Effects estimation or Random Effects estimation. In the literature, there is no clear specification method that is more efficient. Therefore, all of them are estimated and then tested for the more accurate one.

¹¹ Walter Enders, *Applied Econometric Time Series*

The pooled OLS estimator is the simplest approach since this method is based on the simple OLS but in a context of a pooled dataset. It assumes an error term that is normally distributed with mean zero and constant variance, so that:

$$y_{jt} = \alpha_j + \mathbf{x}'_{jt}\beta + u_{jt}$$

The estimator tries to exploit as much information as possible, taking into account effects “within” and “between” individuals, i. e., deviations of individuals from their time-invariant fixed effects and deviations of individuals from their time-averages. It must be taken into account that Pooled OLS estimator assumes the intercept to be a constant ($\alpha_j = \alpha, \forall j$), therefore the model is inconsistent if the intercept is individual-specific as in the Fixed Effect estimator. If the model is appropriate and regressors are uncorrelated with the error term, the estimator is consistent. The errors for a given individual j might be positively correlated over t . “One therefore needs to use panel-corrected standard errors whenever OLS is applied in a panel setting”¹².

The Fixed effects estimator takes into account the individual effect of each country by letting the intercept to change, while having constant coefficients. The variation in the data over time captures the individual-specific deviations of dependent and independent variables from its time-averaged value. α_j is treated as an unobserved random variable that is potentially correlated with the observed regressors \mathbf{x}_{jt} . If errors are iid the estimator yields consistent estimates of β . This specification is limited because time invariant variables such as distance will be excluded from the model, since those are captured by the individual specific effect.

The Random effects estimator treats the intercept as a random variable instead of a parameter estimated for each cross section observation j . The error term is not correlated with the predictors, resulting in possible time-invariant variables playing a role as explanatory

¹² Cameron & Trivedi, *Microeconometrics Methods and Applications*

variables. It makes the additional assumptions that both the errors and the unobserved, time-constant variable are iid:

$$\alpha_j \sim [\alpha, \sigma_\alpha^2]$$

$$u_{jt} \sim [0, \sigma_u^2]$$

If one assumes that α_j can be included into the error term, the RE model can be seen as a specialization of the pooled model. It imposes the additional constraint that the composite error u_{jt} is equicorrelated: the error terms for different i are uncorrelated but the error terms of the same i in two different periods t and s are correlated independently of the distance between t and s .

Due to the contrary assumptions of each estimator, the choice of the model depends on the results of the following tests. A Breusch-Pagan Lagrange multiplier test evaluates the hypothesis that variances across entities are zero. If there is statistical evidence of differences across units, pooled OLS is not the most efficient method and random effects are better fit. To decide between fixed or random effects one should perform a Hausman test in which the null hypothesis is that unique errors, v_j , are not correlated with the regressors. v_j is defined as:

$$y_{jt} = \alpha + \mathbf{x}'_{jt}\beta + [v_j + \epsilon_{jt}]$$

If one rejects the null than fixed effects are most likely to produce better results than random effects. Since Pooled OLS is the model that best fits the data, one needs to account for further issues of the model, namely heteroscedasticity and autocorrelation. Panel-corrected standard errors should be used whenever OLS is applied in a panel setting. Newey-West standard errors mimic the Huber/White/sandwich robust variance estimator with an extension that produces consistent estimates when autocorrelation is present.

It is also possible to correct standard errors with cluster. When performing a simple OLS estimate, one is ignoring that each country appears 42 times in the sample. The standard

errors reported can be misleading since a year where the GDP of a Country grew more typically is a year where the GDP of another Country grew more as well. So the residuals are not independent. One way to deal with this would be to fit a random-effects model - but those were rejected as the best model - or fit the model such that only observations in different Years are treated as truly independent (clustering them by Year).

When including dummy variables for a country j in the regression, one should also be alarmed with the independence of the residuals. Parallel to the previous results, the model can be specified in a way such that only observations in different countries are truly independent (clustering them by country).

4. Sample Size and Data Issues

This study covers a total of 36 trading partners of Angola. The countries are chosen on the basis of importance of trading partnership with Angola and availability of required data. The list of the countries included in the sample is given in Table 1. The quarterly data for all variables have been collected for the period from 2005q1 to 2015q2 (42 quarters). The trade flow data (Exports and Imports) was collected on ITC (International Trade Centre). Nominal GDP, inflation and Real GDP growth was collected on OECD database¹³ (National currency, current prices). Nominal GDP was later transformed in USD\$ by using Exchange rate data from Bloomberg. Oil Price data was collected on Bloomberg. Angola's inflation was collected on *Banco Nacional de Angola*. Data on distance, common language and colonial link was collected on CEPII (*Centre de recherche français dans le domaine de l'économie internationale*). A dummy variable for Oil Producers was computed for Brazil, Canada, India, Mexico, Norway, Russia and USA.

¹³ Except for China: *National Bureau of Statistics of China*

As a modified expenditure equation, trade should enter the estimation in nominal terms. As referred on Benedictis and Taglioni [2011], inappropriate deflators could lead to a spurious or biased estimation. Unless the explanatory variables are orthogonal to the deflators used, if there is a relation between the inappropriate trade deflator and any of those explanatory variables, the coefficient will be biased. Including time fixed effects can account for any different price relationship. By computing nominal and real growth rates, the concern for proper deflators also needs to be taken into account. Since exports are almost exclusively Crude Oil, they will be deflated by oil price. Imports will also be deflated by oil price for comparison reasons and due to the inexistence of better deflators, acknowledging that the results can be biased and inconsistent.

The data has some zero-trade values and log-linear models are unable to efficiently account for them. One solution to deal with this problem is to replace the zero values by a very small positive number (such as 1). However, this procedure could lead to an inconsistent estimator. Since most likely the zero-trade flows are a result of data inconsistency or an approximation of small trade flows, those values will be ignored and the panel model will be unbalanced. This will present no problem if the reason for the missing data is not correlated with the idiosyncratic errors. In contrast, if “observations do not disappear from the panel but certain variables are unobserved for at least some time period”¹⁴ omitting those variables might lead to inconsistent results. Therefore, a robustness check using the Tobit model for censored data will be computed.

¹⁴ Cameron & Trivedi, *Microeconometrics Methods and Applications*

5. Estimation Results

Table 2 provides the panel unit root test results of the variables in study at level form and at first difference. The Schwarz information criterion (SIC) is used to choose the optimum lag for the panel unit root test. The Maddala and Wu, the Im-Pesaran-Shin and the Pesara panel unit root test results provide evidences of first order integration of GDP and integration of order zero for both Exports and Imports. All tests are valid for an unbalanced panel. The sample contains gaps and insufficient observations for some of the variables thus, whenever necessary, some countries were excluded¹⁵. Since inference is not valid if variables have different orders of integration, one cannot extract accurate conclusions for a model with the variables at level form. Thus, one can evaluate if Angola's Trade depend on the growth of the trading partner's economy by applying the first difference on the variables since those are stationary.

Test	Variables	Level form		First Differenced	
		Constant	Constant and Trend	Constant	Constant and Trend
IPS	Exports	-10.07***	-8.29***	-27.94***	-27.46***
Maddala and Wu	Exports	161.22***	150.64***	832.48***	720.31***
Pesaran (CIPS)	Exports	-6.77***	-5.88***	-18.04***	-16.10***
IPS	Imports	-9.72***	-10.07***	-37.10***	-34.41***
Maddala and Wu	Imports	233.23***	183.96***	1191.7***	1055.8***
Pesaran (CIPS)	Imports	-9.09***	-9.05***	-25.93***	-24.24***
IPS	GDP	-3.57***	2.12	-23.67***	-22.57***
Maddala and Wu	GDP	94.66**	20.29	892.75***	805.69***
Pesaran (CIPS)	GDP	1.50	1.74	-26.14***	-25.19***

Table 2: Panel unit root results. IPS combines information from the time series dimension with that from the cross section dimension. MW test assumes cross-section independence. CIPS test assumes cross-section dependence is in form of a single unobserved common factor. *** , ** and * indicates significance at 1%, 5% and 10%, respectively. The Null Hypothesis is such that all panels contain unit roots, against some panels being stationary.

Given the longitudinal characteristics of the data, one should choose the best model considering the properties of the data and the results of criteria tests. Between the panel data models the one that best fits the data is the Pooled estimation. The Hausman test for both real

¹⁵ for Exports: Argentina, Australia, Austria, Czech Republic, Denmark, Finland, Greece, Hungary, Ireland, Luxembourg, New Zealand, Russia, Sweden and Turkey were excluded from the sample

and nominal growth fails to reject the null that the difference in coefficients is not systematic, therefore favoring random effects over fixed effects. The LM multiplier test fails to reject the null that variances across entities are zero. Therefore, the Pooled OLS estimation is the one that best fits the data.

The model will capture the overall effect of the explanatory variables on the dependent variable, giving the same weight to any observation j at any time t as if the data is not longitudinal. In general, this is not the most efficient specification to exploit jointly the within and between variability as time and country dimension are treated similarly. Still, it is possible to capture the variation that emerges through time and country simultaneously rather than testing a time series model for one country or a cross-section model for all countries at one point in time. Therefore, the model ignores country-specific and time-specific effects but provides a comprehensive and generalized response of the explained variable to changes on the regressors.

This approach is used when the groups to be pooled are somewhat homogenous. GDP growth is more likely to behave similarly between countries over time (which raises the question of Time Fixed Effects), rather than within the same country (especially in such a small time frame). That is, a country is more likely to grow within the same path as another one (similar trend behavior at the same quarters), rather than having a specific country effect. Likewise, by failing to reject the null hypothesis of zero variances across entities, one is deducing no significant difference across units, i.e., no panel effect.

Table 3 provides the results with the three model specifications (FE, RE and OLS). The coefficients are very similar between the three specifications for both nominal and real exports. Table 4 presents the test-statistics for Hausman and LM multiplier. Those tests are for the simple model specification and will be recomputed when including other independent variables.

Table 3 – FE, RE and OLS

$$\Delta Y_{jt} = \beta_0 + \beta_1 \Delta GDP_{jt}$$

VARIABLES	Δ Nominal Exports			Δ Real Exports		
	FE	RE	OLS	FE	RE	OLS
Δ Nominal GDP	3.150*** (0.849)	3.061*** (0.835)	3.061** (1.507)			
Δ Real GDP				14.45* (8.340)	12.49* (6.955)	12.49** (5.979)
Constant	0.038*** (0.0064)	0.0390 (0.028)	0.0390 (0.072)	-0.0141 (0.046)	-0.0034 (0.044)	-0.0034 (0.077)
Observations	823	823	823	823	823	823
R-squared	0.008		0.007	0.004		0.004

Table 4 – Hausman and LM Tests

Test		Nominal Exports	Real Exports
Hausman	Prob>chi2	0.74	0.61
LM Multiplier	Prob>chi2	1	1

In order to further exploit the model, the exchange rate was also included as an explanatory variable. The Panel specification allows to identify for each country their respective exchange rate rather than using the effective exchange rate, i.e., an index that describes the relative strength of a currency relative to a basket of other currencies. The real exchange rate ($\theta_j = \frac{e_j p_j^F}{p}$) was computed using the nominal exchange rate (e_j)¹⁶, the CPI of each country as the foreign price (p_j^F) and the Price of Crude Oil as a proxy of the domestic price (p).¹⁷ All variables are stationary when differentiated.

The results considering both nominal and real exchange rate fluctuations as an explanatory variable of nominal exports' are present on table 5 in the appendix. It also provides the test-statistic for Time Fixed Effects which were jointly statistically insignificant. One can infer that both nominal and real exchange rate fluctuations have no statistical significance on

¹⁶ Kwanza is pegged to the dollar, in order to extrapolate the exchange rate between kwanza and the other currencies: $e_j = e_{kwanza\$} * e_{\$j}$

¹⁷ As the main commodity exported

nominal exports growth. Departing from these results, real growth will be computed. The results are shown in table 6.

Table 6 – Pooled OLS (Real Data, Full Sample)

$$\Delta Real Exports_{jt} = \beta_0 + \beta_1 \Delta Real GDP_{jt} + \sum_{k=2}^n \beta_k \Delta X_{kjt}$$

VARIABLES										
$\Delta Real GDP$	14.36**	14.42***	12.17**	12.86**	12.48**	14.02**	14.03**	14.46***	12.82**	13.89**
	(5.582)	(5.550)	(5.362)	(5.291)	(5.410)	(5.449)	(5.449)	(5.557)	(5.275)	(5.512)
$\Delta Real ER$	0.727**									
	(0.329)									
ΔToT		-0.573**				-0.690*	-0.661*	-0.589**		-0.755**
		(0.285)				(0.384)	(0.385)	(0.285)		(0.342)
$\Delta Nominal ER$			0.403							1.438
			(1.105)							(1.270)
$\Delta ER (\$/j)$				-0.362		0.762	0.681		-0.340	
				(1.565)		(1.912)	(1.910)		(1.564)	
$\Delta ER (kwanza/\$)$					0.739	1.173		1.055	0.710	
					(2.220)	(2.211)		(2.221)	(2.211)	
Constant	-0.0391	-0.0316	-0.00333	-0.00741	-0.00990	-0.0392	-0.0284	-0.0417	-0.0134	-0.0404
	(0.0569)	(0.0559)	(0.0537)	(0.0548)	(0.0555)	(0.0582)	(0.0557)	(0.0582)	(0.0571)	(0.0573)
Observations	823	823	823	823	823	823	823	823	823	823

There is statistical evidence that real GDP growth increases real exports growth and that real exchange rate depreciation has a positive impact on the real exports growth. Distance was also included as explanatory variable but lacked significance. Standard-errors were corrected for heteroscedasticity and autocorrelation up to 4 lags¹⁸ by applying a Newey-West correction. In order to understand its effect, the real exchange rate was decomposed in its components. Terms of Trade are the difference between exports' and imports' price (proxied by oil price and inflation as previously mentioned)¹⁹.

From table 6, one can infer that changes on the terms of trade are the driver of the real exchange rate. The nominal exchange rate has no significance either by itself, when

¹⁸ The lag length was chosen arbitrarily. The value 4 was set to try to capture correlation of homologous error terms. Still, when using other lag criteria the results are robust.

¹⁹ $\Delta ToT_j = \Delta Price_{oil} - Inflation_j$, therefore: $\Delta \theta_j = \Delta e_j - \Delta ToT_j$

controlling for changes on Terms of Trade or when decomposed in the kwanza-dollar and dollar-currency_j exchange rate. The results are similar for a sub-sample of 17 and 12 countries (Tables 6.b and 6.c in the appendix) with the exception that the nominal exchange rate can in fact play a significant role in the growth of exports. Therefore, instead of only including the ToT in the regression, the real exchange rate will be used from this point on. For robustness purposes, the same model was computed using different specifications. Table 7 presents the results. All tests provide significant coefficients with the expected sign.

Table 7 – Robustness Check on Real Exports

$\Delta Real Exports_{jt} = \beta_0 + \beta_1 \Delta Real GDP_{jt} + \beta_2 \Delta Real ER_{jt}$

VARIABLES	OLS				Tobit		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta Real GDP$	14.36** (5.932)	14.36* (7.372)	14.36** (6.910)	14.36** (5.582)	16.59*** (6.011)	16.59** (6.975)	16.59*** (6.330)
$\Delta Real ER$	0.727** (0.345)	0.727** (0.260)	0.727*** (0.269)	0.727** (0.329)	0.599* (0.326)	0.599** (0.255)	0.599* (0.329)
Constant	-0.0391 (0.0783)	-0.0391 (0.0472)	-0.0391 (0.0807)	-0.0391 (0.0569)	-0.0520 (0.0775)	-0.0520 (0.233)	-0.0520 (0.0840)
sigma					2.055*** (0.0830)	2.055*** (0.0471)	2.055*** (0.0931)
Observations	823	823	823	823	902	902	902
R-squared	0.009	0.009	0.009				

Table 7: Robustness check. Computed using robust standard-errors (1), standard errors clustered by Country (2) and by Time (3), Newey-West standard errors (4). Also using a Tobit model specification when substituting the zero trade flows by a small value with robust (5), cluster by Country (6) and cluster by Time (7) standard-errors.

Hence, exchange rate shocks influence exports through the price channel (with changes in the nominal exchange rate having an unclear effect). As previously mentioned, since price of oil is determined by oil producers, ER fluctuations can be seen as supply shocks. Moreover, Angola’s trading partners real GDP growth can be seen as demand shocks, as one expects a higher demand for oil in growing countries. The coefficient on ER may be lower than the coefficient associated with real GDP growth, but one can only infer about its true impact by assessing the behavior of those two variables in the sample. Evaluating at the mean and by

one standard-deviation, real GDP growth has a larger effect on real export growth than real exchange rate shocks. Nevertheless, as figure 4 suggests²⁰, ER shocks are much more volatile with frequent and extensive extreme events. It can be argued that real GDP growth was pushed by positive and steady demand shocks while was being exposed to less powerful but more unstable supply shocks. Notice, however, that the model specification is such that we are capturing the overall effect attributing the same weight for every observation. Therefore, these results are not bidding for every country and dynamic effects on real exports are weakly explored.

To argue that two variables can be interpreted as supply and demand forces, one is performing a simple exercise to understand the evolution of exports. Nevertheless, further work is needed, especially to validate and refine the identification of those forces, since it is likely that there are many other sources of disturbances.

Still, to further explore this identification and given the degree of dependence of Angola's economy on the oil market, it would be interesting to resume the analysis on nominal exports. Exports' revenues are crucial for the country's economy as drivers of domestic demand, main source of government budgetary revenues and necessary for the stabilization of the monetary and banking system. Motivated by the lag reaction of nominal exports to price changes, accounting in this way for the frictions in future contracts, a 2 lag variable of the real exchange rate was included²¹. Instead of using nominal GDP growth (which lacked statistical significance), real GDP growth was used.

Nominal exports will decrease with a depreciation shock. When controlling for the two lag exchange rate, the price effect dominates the quantity increase (previously described by real exports growth over real depreciations). Although demand shocks are again larger when

²⁰ In appendix

²¹ One lag had no statistical significance

evaluated at the mean and by one standard-deviation, a sequential decline on the real exchange rate has a greater influence on nominal exports. Including lags on the real GDP growth provide statistical insignificant coefficients. One can argue that demand shocks can have superior effect but if supply shocks are continuous, then the impact of those will be much higher.

Table 8 – Robustness Check on Nominal Exports

$$\Delta \text{Nominal Exports}_{jt} = \beta_0 + \beta_1 \Delta \text{Real GDP}_{jt} + \beta_2 \Delta \text{Real ER}_{jt} + \beta_3 \Delta \text{Real ER}_{jt-2}$$

VARIABLES	OLS				Tobit		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta \text{Real GDP}$	15.02** (6.000)	15.02* (7.329)	15.02** (6.547)	15.02*** (5.652)	17.14*** (6.218)	17.14** (6.945)	17.14*** (5.897)
$\Delta \text{Real ER}_t$	-0.637 (0.391)	-0.637** (0.299)	-0.637** (0.302)	-0.637* (0.352)	-0.856** (0.380)	-0.856*** (0.311)	-0.856** (0.349)
$\Delta \text{Real ER}_{t-2}$	-0.829** (0.419)	-0.829* (0.415)	-0.829** (0.377)	-0.829** (0.410)	-1.085** (0.453)	-1.085** (0.423)	-1.085*** (0.353)
Constant	0.0390 (0.0844)	0.0390 (0.0470)	0.0390 (0.0812)	0.0390 (0.0595)	0.0386 (0.0831)	0.0386 (0.0433)	0.0386 (0.0786)
sigma					2.085*** (0.0873)	2.085*** (0.252)	2.085*** (0.0959)
Observations	790	790	790	790	858	858	858
R-squared	0.014	0.014	0.014				

Table 8: Robustness check. Computed using robust standard-errors (1), standard errors clustered by Country (2) and by Time (3), Newey-West standard errors (4). Also using a Tobit model specification when substituting the zero trade flows by a small value with robust (5), cluster by Country (6) and cluster by Time (7) standard-errors.

As such, given the difficulty of Angola influencing supply shocks and being exposed to high risk of extreme events, studying demand forces in detail can be useful to try to minimize the risks that those can bring to the economy.

Specialization in a narrow group of export products exposes a country to increased instability in export earnings. Angola fails to achieve its exposure to this volatility through diversification of products exported. Nevertheless, it could reduce dependence upon one or a limited number of geographical destinations for its exports. As previously mentioned, the 10

major trading partners absorb a very large amount of total exports. For geographical, economic and political reasons, enlarging the number of partners and diversify the amounts sold to each one of them is a difficult task. Still, as figure 5 in the appendix shows, the concentration of exports have been decreasing for the last 10 years when one excludes China from the analysis. Thus, there are evidences to support a diversification effect. Nevertheless, when including China - the main importer of Angola - in the concentration index, the results are conflicting. There are reasons to be concern that Angola's economy is highly dependent and exposed to the Chinese economic performance. Therefore, one can advocate for a decrease in China's exports share and an increase of the number of partners in order to mitigate the risk of a country's internal shock. As final recommendation, one observes that Oil producing countries have had a lower growth than non-oil producers (table 9 in appendix). The model is specified such that only observations in different countries are truly independent (clustering them by Country).

Regarding Imports there was no need to specify a Tobit model because trade data is complete. Furthermore, because the null hypothesis for time fixed effects is not rejected, one must consider the three model specifications (Pooled OLS, RE and FE) and test for the most appropriate model. Total Exports growth will be used as a proxy for GDP growth. Results show that RE is preferred to the Pooled OLS estimation and that there might be a correlation between individual effects and explanatory variables with real data, although not rejecting the null hypothesis for 1% significance level. Still, since Total Exports do not change between countries, in order to capture its effect, RE estimation was chosen. Table 9 provides the results obtained.

For nominal data the results provide non-significant coefficients. In contrast, for real data, both exports growth rate and real exchange rate fluctuations have a highly statically significant coefficient. The Beta on real exchange rate does not deliver the sign that the

literature predicts. Thus, a modified version of the real exchange rate using Angola's inflation rather than changes on Oil Price was computed. The coefficient presents the expected sign but lacks significance. One can infer that the changes on oil price have such a widespread effect on Angola's economy that even with a real depreciation of the currency, the boost in aggregate demand due to real exports growth lead imports to grow.

Table 9 – Random Effects (Real Data, Full Sample)

$$\Delta Real Imports_{jt} = \beta_0 + \beta_1 \Delta Total Exports_t + \beta_2 \Delta Real ER_{jt}$$

VARIABLES	Δ Nominal Imports				Δ Real Imports			
Δ Nominal Exports	0.181 (0.196)	0.206 (0.203)	0.294 (0.197)	0.195 (0.202)				
Δ Real Exports					0.890*** (0.181)	0.851*** (0.169)	0.497*** (0.184)	0.866*** (0.175)
Δ Nominal ER		-0.304 (0.319)					-0.540* (0.294)	
Δ Real ER			0.257* (0.134)				0.790*** (0.165)	
Δ Real ER(2)				-0.185 (0.292)				-0.359 (0.285)
Constant	0.0240 (0.0363)	0.0245 (0.0360)	0.0133 (0.0371)	0.0247 (0.0362)	0.00953 (0.0428)	0.0121 (0.0417)	-0.00863 (0.0364)	0.0120 (0.0425)
Observations	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417
Number of Time	41	41	41	41	41	41	41	41
Hausman test	-	0.21	0.67	0.23	-	0.01**	0.06*	0.03**
LM test	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***

6. Conclusion

This study intended to be a wide assessment and evaluation on Angola's Trade data since 2005. Given the relevance that Gravity model gained in international economics this analysis was based in the use of this method, combining it with ER fluctuations, contributing for trade policy evaluation in Angola.

The proposed methodology disentangles the drivers behind Exports evolution and then argues for two types of disturbances usefully interpreted as supply and demand forces: supply forces as ER fluctuations and demand forces as foreign GDP growth. Under that interpretation, it

was concluded that demand expansions have a positive effect on nominal and real exports. Furthermore, supply forces are mainly driven by oil price variations with real ER depreciation increasing real exports. Moreover, by controlling for a 2 lag real ER variation, real depreciations decrease nominal exports such that the price decrease dominates the quantities increase. The estimation results suggest that demand forces have a higher impact on both nominal and real exports growth but those are much less volatile than supply shocks. Angola is exposed to extreme exogenous oil price shocks and could hedge against that risk by diversifying the share of trade to its partners.

Imports are capturing the overall performance of the economy and it is reasonable to assume that they are ultimately determined by the performance of the oil market. Again, validating the hypothesis of Angola's increasing dependence of mineral revenues.

Several extensions and possible generalizations merit special consideration. The model is capturing the contemporaneous effect of the variables and does not provide results regarding the long-run effect in the economy. Additional variables should be included so that the model can be closer to reality and in order to improve the identification of supply and demand shocks. Other identification schemes could provide a better understanding of Trade. Due to data restrictions, it was not possible to explore these issues in this work.

7. Bibliography

- Anderson, J. E. 1979. "A Theoretical Foundation for the Gravity Equation". *The American Economic Review*, 69(1), 106–116.
- Anderson, J. E. & Van Wincoop, E. 2003. "Gravity with Gravitas: A Solution to the Border Puzzle". *The American Economic Review*, 93(1), 170–192.
- Baldwin, R. & Taglioni, D. 2006. "Gravity for Dummies and Dummies for Gravity Equations". *NBER Working Paper 12516*.
- Benedictis, L. & Taglioni, D. 2011. "Chapter 4: The Gravity Model in International Trade". In *The Trade Impact of European Union Preferential Policies*. Ed. Luca De Benedictis and Luca Salvatici, Springer, pp.55-89.
- Bergstrand, J. H. 1985. "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence". *The Review of Economics and Statistics*, 67(3).
- Bergstrand, J. H., & Bergstrand, H. 1989. "The Generalized Gravity Equation, Monopolistic Competition, and the factor-proportions theory in International Trade". *The Review of Economics and Statistics*, 71(1), 143–153.
- Blanchard, Olivier. 2009. *Macroeconomics* 5th edition. Pearson.
- Cameron, A. Colin & Trivedi, Pravin K. 2005. *Microeconometrics Methods and Application*. Cambridge. University Press.
- Chaney, T. 2008. "Distorted gravity: The intensive and extensive margins of international trade". *American Economic Review*, 98(4), 1707–1721.
- Cheng, I., & Wall, H. J. 2005. "Controlling for Heterogeneity in Gravity Models of Trade and Integration". *Federal Reserve Bank of St. Louis Review*, 87(1), 49–64.
- Deardorff, A. V. 1998. "Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World?". *NBER Working Paper No. W5377*, (January), 7–32.
- Eaton, J., & Kortum, S. 2002. "Technology, Geography, and Trade". *Econometrica*, 70(5).
- Enders, Walter . 2014. *Applied Econometric Time Series* 4th edition. Wiley.
- Evenett, S. J., & Keller, W. 2002. "On Theories Explaining the Success of the Gravity Equation". *Journal of Political Economy*, 110(2), 281–316.
- Helpman, E., Melitz, M., & Rubinstein, Y. 2007. "*Estimating Trade Flows: Trading Partners and Trading Volumes*. *NBER Working Paper 12927* (Vol. 1).
- Inc., N. A. 2006. *Angola : Diagnostic Trade Integration Study*.
- Kao, C., & Chiang, M. 1998. "On the Inference of a Cointegrating Regression in Panel Data".

Krugman, P. R. 1980. “Scale economies, product differentiation, and the pattern of trade”. *American Economic Review*, 70(5), 950–959.

Krugman, Paul & Wells, Robin. 2015. *Macroeconomics* 4th edition. Worth Publishers.

Muzima, J., & Mazivila, D. 2014. Angola 2014. *Africa Economic Outlook*.

Tinbergen, Jan. 1962. “Shaping the World Economy: Suggestions for an International Economic Policy”. *New York: The Twentieth Century Fund*.

Wooldridge, Jeffrey M. 2010. *Econometrics Analysis of Cross Section and Panel Data* 2th edition. MIT Press.

WTO, & UNCTAD. 2012. “Analyzing bilateral trade using the gravity equation”. *A Practical Guide to Trade Policy Analysis*, 101–136.