# Does Inflation Uncertainty Matter for Validity of Romer's Hypothesis? Evidence from Nigeria.

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# Openness and Inflation in Nigeria: Does Inflation Uncertainty Matter for Validity of Romer's Hypothesis?

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**Abstract**

*Romer (1993) posits openness to international restricts inflation. He offers an explanation based on time-inconsistency of monetary policy, however ensuing studies have raised questions on the validity of Romer's assertion and its explanation. The aim of this paper was to estimate the effect of trade openness on inflation employing quantile regression analysis, contrary to traditional mean regression methods using annual data from Nigeria for the period 1970 to 2016. The paper also tested the hypothesis of whether inflation uncertainty influence the validity of Romer's hypothesis for Nigeria. The study adopted two measures of openness – share of trade to GDP and KOF globalization index. The results of the study validate Romer's hypothesis for both openness indexes that openness restrict inflation. With the inclusion of inflation uncertainty, the estimated impact of trade openness on inflation was quantitatively larger and the t-statistic on the interaction variable is significant in all quantiles except for the median quantile (0.50) and their coefficients are positive. The study concluded that in all distributions of inflation, inflation uncertainty reduces the ability of openness to trade in curbing inflation. Therefore, it recommends that policy maker should target and control inflation uncertainty when openness is employed as key policy instrument for controlling inflation.*

**Keywords**: Trade openness, inflation, globalization index, inflation uncertainty, quantile regression.

**JEL Code:** C12, C22, E31, F41

## 1. Introduction

Inflation is considered to be a major economic problem all over the world; as a result, monetary authorities globally devote a significant amount of resources to put it under control. Therefore, the primary objective of monetary policy is to ensure price stability. Price stability however does not mean constant price level, rather it implies that the rate of change of the general price level is such that economic agents do not worry about it. Inflation imposes costs on real economic output in every economy and this welfare cost is higher in developing economies, where inflation rate is mostly double digit. As a result, there is need for policy makers in developing nations to understand the major channels through which inflation affects the real economy so as to reduce the detrimental economic effects and welfare costs of increase in price level. Upon this premise of controlling inflation, Triffin and Grudel (1962) opined that openness to trade may be one of the ways to reduce high inflation because openness enhances availability of cheaper goods and services from international markets for domestic consumption.

Studies on the nexus between openness to international trade and inflation are increasing in recent times, both in the theoretical as well as empirical fronts among which are Gruben and McLeod (2004), Kim *et al.* (2012) and Haq, Alotaish, Kumara and Otamurodov (2014). Researchers are of opinion that the relationship between inflation and openness has dual effects. For instance, higher imports to a country akin to greater openness could reduce the price level in the domestic economy as the international price level is expected to be lower than domestic price level for developing country such as Nigeria. On the other hand, increasing imports by home country could adversely affect her current account balance and consequently depreciate the value of the domestic currency, which could subsequently lead to inflation. Whether or not trade openness has a net effect of restricting inflation remain an empirical issue.

This paper contributes to this debate by estimating the effect of openness to international trade on inflation using quantile regression, contrary to traditional mean regression methods in which the slope coefficient is constrained to be the same for all quantiles, as such there is insufficient information on how policy variables affect target variable at different locations of its conditional distribution. This might provide an explanation for inconsistence in the sign of relation between openness and inflation. Adopting two measures of openness – share of trade to GDP and KOF globalization index,

the study also tests the hypothesis of whether inflation uncertainty influence the validity of Romer's hypothesis for Nigeria. These gaps has not been filled in existing literature.

This paper proceeds as follows: section 2 presents the literature review and section 3 describes method and data employed. Section 4 reports the results of analysis and discussion of findings is covered in section 5. Section 6 contains the conclusion and recommendations.

## 2. Literature Review

In his seminal paper, Romer (1993), used a Barro-Gorden type model to explain that trade openness puts a check on the government's incentive to engage in unanticipated inflation, because of induced exchange rate depreciation. He demonstrated that average inflation rate to be lower for smaller and relatively more open economies. Several studies have tested Romer's argument in different ways and found support for the conventional view of negative relationship between trade openness and inflation. Among such studies are Sachsida *et al.*, (2003), Hanif and Batool (2006), Samimi, Ghaderi, Hosseinzadeh and Nademi (2012), Ada, Adejumo, Adekanye, Okoruwa and Obi-Egbedi (2014), Wahu (2016), Rangkakulnuwat and Thurner (2017) and Lin, Mei, Wang and Yao (2017). However, this negative relationship has been called into question by studies who found positive relationship between trade openness and inflation such as Alfaro (2005); Kim and Beladi (2005), Evan (2007), Zakaria (2010) and Zombe *et al.* (2017).

Other studies has attempted to explain further the openness-inflation nexus by considering an alternative measure of openness. For example, Samimi *et al.* (2012) investigated the relationship between openness and inflation for developed and developing countries by using both traditional (trade share of GDP) and comprehensive Index (economic globalization – one dimension of the new KOF globalization index); the study concluded that the comprehensive index (KOF index) is a better measure for openness. Their submission was based on the fact that traditional openness index does not support Romer's negative assertion between inflation and openness. Similarly, Dahmardeh and Mahmoodi (2013) employed dynamic OLS estimator for a panel of 15 OECD countries and found support for Romer's hypothesis. In contrast to other other studies, Mahmoudzadeh and Shadabi (2012) who considered trade freedom index of heritage foundation as measurement for openness and found a positive effect of openness on inflation.

Beyond the issue of alternative measurements for openness raised in previous studies, Haq, Zhu, Shafiq and Khan (2016) applied ordinary least squares, dynamic OLS and

generalized method of moments (GMM) to two models on the basis of two different indexes of trade openness (traditional and comprehensive indexes). The study concluded that method of estimation matters in case of the association between openness and inflation rather than measure of openness,. Abbaspour, S., Fatahi, S. and Nazifi, M. (2011) employed quantile regression analysis to investigate openness-inflation nexus for iran. The quantile regression studies the relation between inflation and openness in different quantiles of inflation levels. Their findings showed positive effect of trade openness on inflation when inflation is higher but no effect when inflation is lower and surmised that the positive relationship is stronger along with the inflation.

## 3. Methods

### 3.1 Quantile Regression

Beyond the standard linear regression model framework, the study employed quartile regression model introduced in Koenker and Bassett (1978) as an extension of classical least squares estimation of conditional mean models to the estimation of the whole conditional distribution of response variable (see Koenker, 2005).

As described by Koenker and Bassett (1978), the estimation of $\boldsymbol{\beta}$ is done by minimizing equation (1);

$$\hat{\beta}_{\tau} = min_{\beta \epsilon \Re k} [\tau \sum_{yt \geq xt\beta} | y_t - \boldsymbol{x}_t'\boldsymbol{\beta} | + (1-\tau) \sum_{yt < xt\beta} | y_t - \boldsymbol{x}_t'\boldsymbol{\beta} | \quad (1)$$

The quantile function is a weighted sum of the absolute values of the residuals. Where the weights are symmetric for the median regression case in $\tau = ½$, the minimization problem above reduces to $min_{\beta \epsilon \Re k} \sum_{t=1}^{T} |(y_t - \boldsymbol{x}_t'\boldsymbol{\beta})|$ and asymmetric otherwise. It thus can be observed that varying the parameter $\tau$ on the [0,1] interval will generate the entire conditional distribution of inflation (*inf*) and trade openness (*open*) series. The coefficient $\beta_i(\tau)$ can then be interpreted as the marginal impact on the $\tau^{th}$ conditional quantile due to a marginal change in the $i^{th}$ policy variable.

Under traditional mean regression methods the slope coefficient is constrained to be the same for all quantiles, as such there is insufficient information on how policy variables affect countries or target variables differently. Mello and Novo (2002) construed that the ability to distinguish the effects of policy variables among different quantiles is important empirically.

Hence, the study will estimate equation (2) specify as;

$$inf_i = \rho_\tau + \delta_\tau open_i + \epsilon_\tau Z_i + \varepsilon_{\tau i} \quad (2)$$

Where *inf* is inflation, $open_i$ represent measures of openness and *Z* stands for control variables are as previously defined, $\rho_\tau$, $\delta_\tau$, and $\epsilon_\tau$ are parameters to be estimated for different values of $\tau$ and, $\varepsilon_{\tau i}$ is the random error term. Varying $\tau$ from 0 to 1, the study can trace the entire distribution of inflation rate variable conditional on trade openness size variable.

### 3.2 Data

The data set for this study covers the period between 1970 and 2016. The key variables for the subsequent econometric analyses are openness and inflation in Nigeria and they are sourced from World Development Indicators (WDI). In addition, for robustness checks, the study includes variables related to inflation such as government size (*gov*), government debt ratio to GDP (*debt*) and financial openness, proxy by FDI (*fdi*). The data for these variables are obtained from Central Bank of Nigeria Statistical Bulletins. Inflation is measured by change rate in the GDP deflator (annual %). Two measures of openness are adopted. First, openness is measured as the share of both exports and imports in GDP and it is indicated as *tropen*. According to Lin, Mei, Wang and Yao (2017), this measure is as robust as the average share of imports (including goods and services) in GDP employed by Romer (1993). Secondly, KOF Globalization index is used as a measure of openness (*KOF*). Data on KOF index is obtained from KOF Swiss Economic Institute, Switzerland.

In order to construct inflation uncertainty (*vinf*), the study follows Bowdler and Malik (2005) and compute it as;

$$vinf = \ln[1 + std(inf)] \quad (3)$$

where std denotes a standard deviation and *inf* is the decimal inflation rate.

## 4. Empirical Results

### 4.1 Unit Root and Cointegration Test Results

In order not to run spurious regression, this study first examine the stationarity of the key variables using Dicky-Fuller generalized least square (DF-GLS) unit root test because of its power ptoperties over ADF (Dicky & Fuller, 1979) and PP (Philip & Perron, 1988) tests (Dejong *et al*, 1992). The results of the DF-GLS test are as presented in Table 1 and it shows that the two measures of openness (*tropen* and *KOF*) along with ratios of government expenditure to GDP and public debt to GDP are integrated of order one, I(1). While other variables are stationary at level. The study thereafter, applied the Johansen–Juselius (1990)

technique to determine whether there is at least one linear combination of these I(1) variables that is I(0).

**Table 1: Unit Root Test Result**

| Variables | Levels | First difference | Critical value (5%) | Critical value (1%) | Decision |
|---|---|---|---|---|---|
| *inf* | 03.344** | - | -1.948 | -2.618 | I(0) |
| *tropen* | -1.910[a] | -9.190** | -1.948 | -2.618 | I(1) |
| *KOF* | -0.073 | -6.604** | -1.948 | -2.618 | I(1) |
| *debtsz* | -.0807 | -5.445** | -1.948 | -2.618 | I(1) |
| *govsz* | -1.745[a] | -9.929** | -1.948 | -2.618 | I(1) |
| *ms* | -2.077* | -6.065** | -1.948 | -2.618 | I(0) |
| *fdi* | -3.577** | - | -1.948 | -2.618 | I(0) |
| *vinf* | -3.928** | - | -1.948 | -2.618 | I(0) |

Notes: Mackinon critical values for rejection of hypothesis of a unit root

[a] Variable is stationary at the 10% level

[*] Denotes significance at the 5% level

[**] Denotes significance at the 1% level

The results of the Max-Eigen and the Trace tests are reported in panel A of Table 2 (when openness is measured as the share of both exports and imports in GDP). The results suggest that the null hypothesis of no co-integration can be rejected either using Max-Eigen or the Trace tests statistics. They are both greater than their critical values. The co-integrating equation (normalized on inflation variable) shown in panel B of Table 2 indicates that trade openness (*tropen*) has negative sign while money supply, government size, public debt and foreign direct investment are positive (the sign are reversed because of the normalization process). The coefficients are all significant as shown by the *t*-ratios indicated in parentheses.

**Table 2: Cointegration results (Model with *tropen*)**

| Panel A: Estimates of Max-Eigen and Trace tests | | | | | |
|---|---|---|---|---|---|
| Null | Alternative *r* | Max-Eigen | Critical value (0.05) | Trace | Critical value (0.05) |
| 0 | 0.6957 | 52.3556 | 40.0775 | 100.737 | 95.7536 |

| | | | | | |
|---|---|---|---|---|---|
| ≤1 | 0.3463 | 18.7048 | 33.8768 | 48.3821 | 69.8188 |
| ≤2 | 0.2678 | 13.7152 | 27.5843 | 29.6773 | 47.8513 |
| Panel B: Estimates of co-integrating vector | | | | | |
| *inf* | *tropen* | *ms* | *govzt* | *debtzt* | *fdi* |
| 1.0000 | 0.4103<br>(4.61) | -0.3645<br>(2.01) | -2.0748<br>(8.46) | -0.0163<br>(5.10) | -8.6636<br>(12.21) |

*Note: t-ratios are in parentheses*

Similarly, in the model where *KOF* serves as a measure of openness, results of the Max-Eigen and the Trace tests are reported in panel A of Table 3 indicate that the null hypothesis of no co-integration can be rejected under both tests. The co-integrating equation shown in panel B of Table 3 reports the same pattern of relationship among the variable except that the coefficient of trade openness (*KOF*) is not significant at 5 percent level.

**Table 3: Cointegration results (Model with KOF)**

| Panel A: Estimates of Max-Eigen and Trace tests | | | | | |
|---|---|---|---|---|---|
| Null | Alternative *r* | Max-Eigen | Critical value (0.05) | Trace | Critical value (0.05) |
| 0 | 0.6957 | 45.6514 | 40.0775 | 104.0335 | 95.7536 |
| ≤1 | 0.3463 | 19.2014 | 33.8768 | 48.2820 | 698188 |
| ≤2 | 0.2678 | 14.5859 | 27.5843 | 29.0805 | 47.8561 |
| Panel B: Estimates of co-integrating vector | | | | | |
| *inf* | *KOF* | *ms* | *govzt* | *debtzt* | *fdi* |
| 1.0000 | 0.4391<br>(1.6353) | -0.7267<br>(3.11) | -1.5816<br>(4.72) | -0.0189<br>(4.96) | -7.1945<br>(8.6984) |

*Note: t-ratios are in parentheses*

The co-integrating equation of the two models of openness indicates that trade openness has negative sign, which imply that negative association between openness and inflation hold for both traditional and comprehensive measure openness.

### 4.2 Quantile Results

Next, contrary to traditional mean regression methods in which the slope coefficient is constrained to be the same for all quantiles, the study estimates the effect of openness to international trade on inflation using quantile regression and presented the results in Table 4.

**Table 4: Quantile Regression Results**

| | | **with Trade Openness as Measure of Openness** | | **KOF as Measure of Openness** | |
|---|---|---|---|---|---|
| Variable | Tau | Model 1 | Model 2 | Model 3 | Model 4 |
| *Constant* | 0.05 | -5.187 (-3.895)*** | -34.462 (-19.52)*** | -4.34 (-0.91) | -62.67 (-25.52)*** |
| | 0.25 | 7.623 (10.901)*** | -44.958 (-7.14)*** | 14.79 (12.88)*** | 0.63 (0.21) |
| | 0.50 | -7.627 (-1.657) 35.806 | -50.289 (-2.33)** | 11.74 (0.69) | -34.30 (-4.11)*** |
| | 0.75 | (5.240)*** 24.229 | -14.030 (-0.57) | 38.77 (3.39)*** | -24.72 (-2.78)** |
| | 0.95 | (1.622) | 21.613 (1.75)* | 135.11 (10.59)*** | 61.75 (1.76)* |
| *Tropen* | 0.05 | -0.036 (-2.418)** | -0.576 (-17.17)*** | -0.09 (-0.90) | -0.14 (-2.31)** |
| | 0.25 | -0.082 (-10.442)*** - | -0.588 (-4.92)*** | -0.34 (-13.98)*** | -1.95 (-26.58)*** |
| | 0.50 | 0.038 (-0.740) | -0.761 (-1.85)* | -0.48 (-1.33) | -1.21 (-5.85)*** |
| | 0.75 | -0.321 (-4.167)*** | -1.400 (-3.00)*** | -0.77 (-3.13)*** | -1.49 (-6.78)*** |
| | 0.95 | 0.822 (4.883)*** | -2.313 (-9.87)*** | -0.88 (-3.22)*** | -3.64 (-4.18)*** |
| *ms* | 0.05 | 0.188 (6.201)*** | 0.009 (1.16) | 0.21 (2.43)** | 0.01 (1.47) |
| | 0.25 | -0.087 (-5.493)*** | 0.016 (5.59)*** | -0.05 (-2.36)** | -0.02 (-2.29)** |

| | | | | | |
|---|---|---|---|---|---|
| | 0.50 | -0.248 | -0.045 | -0.10 | 0.04 |
| | | (-2.362)** | (-0.44) | (-0.32) | (1.63) |
| | 0.75 | -0.560 | 0.014 | -0.26 | -0.00 |
| | | (-3.585)*** | (0.12) | (-1.23) | (-2.79)** |
| | 0.95 | -0.141 | 0.026 | -2.14 | -0.10 |
| | | (-0.414) | (0.46) | (-8.91)*** | (-0.92) |
| | 0.05 | 0.200 | 0.002 | 0.17 | 0.007 |
| | | (5.034)*** | (0.20) | (1.48) | (0.72) |
| *govzt* | 0.25 | 0.141 | 0.181 | 0.05 | 0.38 |
| | | (6.753)*** | (4.65)*** | (2.03)** | (31.15)*** |
| | 0.50 | 1.040 | 0.423 | 0.83 | 0.32 |
| | | (7.559)*** | (3.17)*** | (2.03)** | (9.47)*** |
| | 0.75 | 0.370 | 0.228 | 0.58 | 0.13 |
| | | (1.813)* | (1.50) | (2.10)** | (3.73)*** |
| | 0.95 | -1.103 | -0.130 | -0.73 | -0.32 |
| | | (-2.468)** | (-1.70) | (-2.36)** | (-2.22)** |
| *debtzt* | 0.05 | 0.004 | -4.773 | 0.005 | 0.000 |
| | | (7.856)*** | (-0.33) | (3.768)*** | (1.88)* |
| | 0.25 | 0.001 | 0.001 | 0.005 | 0.004 |
| | | (5.009)*** | (2.64)** | (15.20)*** | (27.80)*** |
| | 0.50 | 0.007 | 0.002 | 0.009 | 0.005 |
| | | (3.924)*** | (1.57) | (1.94)* | (13.13)*** |
| | 0.75 | -0.006 | 0.001 | 0.006 | 0.002 |
| | | (-2.302)** | (0.55) | (1.85)* | (4.91)*** |
| | 0.95 | -0.012 | -0.002 | -0.015 | -0.007 |
| | | (-2.054)** | (-2.75)*** | (-4.16)*** | (-4.21)*** |
| *fdi* | 0.05 | 1.432 | -0.030 | 1.77 | 0.14 |
| | | (13.321)*** | (-0.93) | (6.05)*** | (4.74)*** |
| | 0.25 | 1.828 | 0.502 | 3.36 | 1.21 |
| | | (32.378)*** | (4.37)*** | (47.67)*** | (33.70)*** |
| | 0.50 | 4.316 | 1.770 | 4.64 | 1.99 |
| | | (11.613) | (4.50)*** | (4.48)*** | (19.67)*** |
| | 0.75 | 4.646 | 1.954 | 4.52 | 1.41 |

| | | | | | |
|---|---|---|---|---|---|
| | | (8.419)*** | (4.37)*** | (6.44)*** | (1.31) |
| | 0.95 | 4.860 | 1.471 | 5.61 | -0.15 |
| | | (4.030)*** | (6.54)*** | (7.16)*** | (-0.36) |
| *vinf* | 0.05 | | 8.862 | | 14.06 |
| | | | (26.15)*** | | (29.59)*** |
| | 0.25 | | 10.126 | | 1.02 |
| | | | (8.38)*** | | (1.78)* |
| | 0.50 | | 10.558 | | 8.98 |
| | | | (2.54)** | | (5.56)*** |
| | 0.75 | | 4.069 | | 7.34 |
| | | | (0.86) | | (4.27)*** |
| | 0.95 | | -1.597 | | -8.77 |
| | | | (-0.67) | | (-1.29) |
| *vinf*tropen* | 0.05 | | 0.107 | | 0.024 |
| | | | (16.91)*** | | (2.08)** |
| | 0.25 | | 0.108 | | 0.35 |
| | | | (4.76)*** | | (24.89)*** |
| | 0.50 | | 0.134 | | 0.17 |
| | | | (1.73)* | | (4.40)*** |
| | 0.75 | | 0.269 | | 0.26 |
| | | | (3.05)*** | | (6271)*** |
| | 0.95 | | 0.470 | | 0.7734 |
| | | | (10.60)*** | | (4.57)*** |

Figures in parentheses stand for t-ratios, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively.

The results of estimation of quantile regression with openness measured as the share of both exports and imports in GDP is presented under Model 1 and Model 2 in Table 4. In Model 1, the coefficients of these variables are significant in all quantile except 0.95 quantile for money supply and 0.75 quantile for government size. The implication of these for inflation-openness nexus is that except for upper quantile (0.95) with positive sign, openness leads to reduction in inflation. The inclusion of measure of inflation uncertainty and its interaction with openness in the model allows for test of the hypothesis of whether inflation uncertainty

matters in inflation – openness relation. The effect is to check whether the link between openness and inflation is robust to these inclusions. The result is reported in Model 2. The coefficients of openness in all the quantiles are negative, except quantile 0.95 and are all statistically significant at 5 percent level.

At low and middle inflation distribution (i.e quantile 0.05, 0.25 and 0.5), there is evidence that inflation uncertainty leads to rise in inflation. The t-statistic on openness showed that a statistically significant negative relationship exist between openness and inflation, as the theory predicts. Comparing model 2 with model 1 reveals that with the inclusion of inflation uncertainty, the estimated impact of openness on inflation is quantitatively larger. The t-statistic on the interaction variable is significant in all quantiles except for the median quantile (0.50) and their coefficients are positive. This implies that inflation uncertainty mitigates the negative effect of openness on inflation. For instance, in the 0.05 quantile (low inflation), the estimated effect of openness on the inflation will change from -0.051 to 0.044 as the measure of inflation uncertainty changes from its twenty-fifth percentile value (4.9) to the seventy-fifth percentile value (5.8). Similarly for 0.95 quantile (high inflation), effect of openness on the inflation will change from -0.01 to 0.41 (see Appendix 1). This suggests that the net impact of openness on level of inflation depends on the degree of inflation uncertainty. Consequentially, when the rate of inflation is high, achieving success in reducing inflation through openness become a mirage.

Using the KOF as a measure of openness in quantile regression specification, the findings is not significantly different from conclusions obtained when openness was measure as ratio of import and export to GDP. Model 1 in Table 4 showed that the coefficients of openness variable in all the quantiles are negative and significant for 0.25, 0.75 and 0.95 quantiles. Again almost all the control variables are statistically significant. This suggests that openness restricts the level of inflation. Model 2 provides the result of the inclusion of inflation uncertainty and its interaction with openness and the result is not significantly different from the one obtained when openness was measured as share of GDP. For instance, the estimated impact of openness on inflation is also quantitatively larger and the t-statistic on the interaction variable is significant in all quantiles with positive coefficients. The implication of the positive signs is that in all distributions of inflation, inflation uncertainty mitigates the negative effect of openness on inflation.

## 5. Discussions

The study adopted two measures of openness – share of trade to GDP and KOF globalization index. The results of the study validate Romer's hypothesis that openness restrict inflation for the two measures of openness. This findings is consistence with Samimi et al. (2012) and Haq, Zhu, Shafiq and Khan (2016), who surmised that irrespective of the measure of openness adopted, openness reduces inflation. This conclusion opposes Mahmoudzadeh and Shadabi (2012) who surmise that a positive effect of openness on inflation when trade freedom index was employed as measurement for openness. More so, in terms of method, the results does not uphold the positive stance of Abbaspour, S., Fatahi, S. and Nazifi, M. (2011) from their quantile regression analysis for Iran. The question, then, is what are the policy implications of these findings for the Nigerian economy?

One, the results suggest that policy makers in Nigeria should continue to make advance towards liberalising its external trade. However, adopting international trade openness as a policy geared toward controlling inflation should be done with caution. This position is based on the premise that Nigeria's export base is weak and primary goods constitute the large amount of her exports (outside crude oil export). According to African Economic Outlook (2017), agriculture accounts for about 30.9% of the GDP, 70.0% of employment but contributes only about 2.5% of export earnings while crude oil and natural gas account for about 15.0% of GDP, 71.0% of export earnings and 79.0% of government revenue. On the other hand, Nigeria's major imports are refined petroleum products (i.e 85% of domestic consumption), which have multiplier effect on every sector of the economy being the major source of energy, and food importation to complement domestic food production for household and industrial sector. It thus follows that without strong structure and strategy high prices in foreign markets will permeate into the Nigerian economy and openness strategy becomes counter-productive as a policy tool to reducing inflation.

The results equally show that inclusion of inflation uncertainty makes the result more robust quantitatively. With the inclusion of inflation uncertainty, the estimated impact of openness on inflation is quantitatively larger and the t-statistic on the interaction variable is significant in all quantiles except for the median quantile, and their coefficients are positive. This result is in line with the findings of Fang, Miller and Yeh (2007), Chowdhury (2011), Hachicha and Lean (2013), Sharaf (2015) and Alimi (2017), which provide evidence of positive association between inflation and its uncertainty thus confirming Cukierman and Meltzer (1986) hypothesis. The implication of the positive signs of inflation uncertainty is that in all distributions of inflation, it reduces the ability of openness to restrict inflation. As a

result, policy-makers' effort at reducing the level of inflation uncertainty becomes a necessary condition to achieving a favourable net impact of openness on inflation.

Finally, the sign of relation between inflation and the control variables reflect similar pattern in both models for openness. For instance, there is evidence that money supply, foreign direct investment, size of public debt and share of government to GDP are significant factors that raise inflation level in Nigeria, at low and middle inflation distribution.

## 6. Conclusion and Recommendations

International trade between countries of the world is an important economic index to be considered. However, opening up a nation's economy will not only improve trade of such a country, but will also affect some of its macroeconomic indicators especially inflation rate, which is an important factor for policy decision makers in every economy. This paper contributes to the debate on validity of Romer's hypothesis by estimating the effect of openness to international trade on inflation using quantile regression. Thus providing an explanation for inconsistence in the sign of relation between openness and inflation in literature.

The findings of the study validate Romer's hypothesis that openness restrict inflation and that inflation uncertainty matters in openness-inflation nexus. Therefore, it recommends that policy maker should target and control inflation uncertainty when openness is employed as key policy instrument for controlling inflation.

## References


Abbaspour, S., Fatahi, S. and Nazifi, M. (2011). The Effect of Openness on Inflation, Using Quantile Regression: A Case Study of Iran. Retrieved January 17, 2018 from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2124478

Ada, O. A., Adejumo, O., Adekanye, J. O., Okoruwa, V. O. and Obi-Egbedi, O. (2014). Trade Openness and Inflation in Nigerian Economy: A Vector Error Correction Model (VECM) Approach. *Research Journal of Finance and Accounting, 5*(21).

African Economic Outlook (2017). www.africaneconomicoutlook.org

Alfaro, L. (2005). Inflation, openness and exchange-rate regimes: The quest for short-term commitment. *Journal of Development Economics*, *77*(1), 229-249

Alimi, R. S. (2017). Inflation rates and inflation uncertainty in Africa: A quantile regression approach. *International Journal of Academic Research in Business and Social Sciences, 7*(11)

Bowdler, C. and Malik, A. (2005). Openness and inflation volatility: Cross-country evidence. CSAE Working Paper Series, 2005-08.

Chowdhury, A. (2011). Inflation and inflation-uncertainty in India: The policy implications of the relationship. Marquette University, Department of Economics Working Paper -04

Cukierman, A. and Meltzer, A. (1986). A Theory of Ambiguity, Credibility, and Inflation under Discretion and Asymmetric Information. *Econometrica, 54*(5):1099–1128.

Dahmardeh, N. and Mahmoodi, E. (2013). The effect of economic globalization on inflation in 15 OECD countries. *International Journal of Basic Sciences & Applied Research, 2*(5), 439-444

DeJong, D. N., Nankervis, J. C., Savin, N. E and Whiteman, C. H. (1992). Integration versus trend stationarity in time series. *Econometrica, 60,* 423-433.

Dickey, D. and Fuller, W. (1979). Distribution Of The Estimators For Autoregressive Time Series With A Unit Root. *Journal of the American Statistical Association, 74*, 427–731. Doi: 10.1177/1091142105277627.

Dreher, A. (2006). Does Globalization Affect Growth? Empirical Evidence from a new Index, *Applied Economics 38*(10), 1091-1110.

Dreher, A. Noel, G. and Pim, M. (2008). *Measuring Globalization - Gauging its Consequence* , New York: Springer.

Evans, R.W., (2007). *Is openness inflationary? Imperfect competition and monetary market power, Federal Reserve Bank of Dallas*. Globalization and Monetary Policy Institute, Working Paper No.1.

Fang, W. S., Miller, S. M. and C. C. Yeh. (2007). Quantile inferences for inflation and its variability: Does a threshold inflation rate exist? Working Paper, 200745 http://digitalcommons.uconn.edu/ econ_wpapers/200745

Gruben, W. and McLeod, D. (2004). The Openness-Inflation Puzzle Revisited. *Applied Economics Letters, 11*(8), 465-68.

Hachicha, A. and Lean, H. H. (2013).Inflation, Inflation Uncertainty and Output in Tunisia. Economics Discussion Papers, No 2013-1, Kiel Institute for the World Economy. Retrieved January 24, 2018 from http://www.economics-ejournal.org/economics/discussionpapers/2013-1

Hanif, M. N., and Batool, I. (2006). Openness and Inflation: A case study of Pakistan. *MPRA Paper, No.10214*, University Library of Munich, Germany.

Haq, I. U., Zhu, S., Shafiq, M. and Khan, A. (2016). Does proxy of openness or methodology matter to hold Romer's hypothesis? *International Journal of Economics, Commerce and Management, 4*(1), 1-12.

Haq, I., Alotaish, M. S. M, Kumara, N. G. S, and Otamurodov, S. (2014). Revisiting The Romer's Hypothesis: Time Series Evidence from Small Open Economy. *Pakistan Journal of Applied Economics, 24*(1), 1-15

Hohl, K. (2009) Beyond the Average Case: The Mean Focus Fallacy of Standard Linear Regression and the Use of Quantile Regression for the Social Sciences. Retrieved May 17, 2017 from https://ssrn.com/abstract=1434418 and http://dx.doi.org/10.2139/ssrn.1434418

Johansen, S. and Juselius, K. (1990). "Maximum Likelihood Estimation and Inference on Cointegration with applications to the Demand for Money", Oxford Bulletin of Economics and Statistics, 52, 2 (May): 169-210.

Kim, M and H. Beladi (2005), Is free trade deflationary? *Economics Letters*, *89*(3), 343-349.

Kim, Y. K., Lin, S. C., & Suen, Y. B. (2012). The simultaneous evolution of economic growth, financial development, and trade openness. *The Journal of International Trade & Economic Development*, *21*(4), 513-537. http://dx.doi.org/10.1080/09638199.2010.497933

Koenker, R. (2005). *Quantile Regression*. Cambridge University Press. Pp116-149

Koenker, R. and Bassett, G. (1978). Quantile regression. *Econometrica* 46, 33-50.

Kuan, C. M. (2007). An Introduction to Quantile Regression. Retrieved June 11, 2016 from avesbiodiv.mncn.csic.es

Lin, F., Mei, D. Wang, H. and Yao, X (2017). Romer was right on openness and inflation: evidence from Sub-Saharan Africa. *Journal of Applied Economics. 20*(1),121-140

Lin, F., Mei, D. Wang, H. and Yao, X. (2017). Romer was right on openness and inflation: Evidence from Sub-Saharan Africa. *Journal of Applied Economics, 20*(1), 121-140

Mahmoudzadeh, M. and Shadabi, L. (2012). Inflation and trade freedom: An empirical analysis. *World Applied Sciences Journal*, 18(2), 286-291.

Mello, M and Novo, A (2002). The New Empirics of Economic Growth: Quantile Regression Estimation of Growth Equations. Retrieved on June 11 2017 from www.economia.puc-rio.br/pdf/seminario/marcelo_melo.PDF

Mohammad, R. L., Samaneh, M. and Somayeh, S. (2013). Trade Openness and Inflation. Evidence from MENA Region Countries. *Economic Insights – Trends and Challenges, 2(2), 1-11*

Nigeria Population Commission (2017).. www.population.gov.ng

Phillips P.C.B. and Perron P. (1988). Testing for a unit root in a time series regression. *Biometrika, 75*, 335-346.

Rangkakulnuwat, P. and Thurner, P. (2017). *Trade openness and inflation: an empirical evidence of Thailand*. Proceedings of 76th The IRES International Conference, Osaka, Japan, 8th-9th August. 33-36

Romer, D. (1993). Openness and inflation: Theory and evidence. *Quarterly Journal of Economics 108*(4), 869-903.

Sachsida, A., Carneiro, F. G., & Loureiro, P. R. (2003). Does greater trade openness reduce inflation? Further evidence using panel data techniques. *Economics Letters*, *81*(3), 315-319.

Samimi, A, J., Ghaderi, S., Hosseinzadeh, R. and Nademi, Y. (2012). Openness and inflation: New empirical panel data evidence. *Economics Letters, 117*, 573-577.

Sharaf, M. F. (2015). Inflation and Inflation Uncertainty Revisited: Evidence from Egypt. *Economies 3*, 128-146

Triffin, R. and Grudel, H. (1962). The Adjustment Mechanism to Differential Rates of Monetary Expansion among the 10 Countries of the European Economic Community. *Review of Economics and Statistics*, *44*, 486-91.

Triffin, R. and Grudel, H. (1962). The Adjustment Mechanism to Differential Rates of Monetary Expansion among the 10 Countries of the European Economic Community. *Review of Economics and Statistics*, *44,* 486-91

Wahu, M. C. (2016). *Relationship between Openness and Inflation in Kenya: Testing Romer Hypothesis using Autoregressive Distributive Lag*. (B.Sc. Project, Strathmore University, Strathmore Institute of Mathematical Sciences, Strathmore University Nairobi, Kenya).

Zakaria, M. (2010). Openness and inflation: evidence from the time series data. *Dogus Universitesi Dergisi*, *11*(2), 313-322.

Zombe, C., Daka, L, Phiri, C., Kaonga, O., Chibwe, F. and Seshamani, V. (2017). Investigating the Causal Relationship between Inflation and Trade Openness using Toda–Yamamoto Approach: Evidence from Zambia. *Mediterranean Journal of Social Sciences, 8*(6), 171-182

## Appendix 1: Series on Inflation and inflation Uncertainty

| Year | Inflation Rate | Inflation Uncertainty |
|---|---|---|
| 1970 | 13.75708 | 5.402649 |
| 1971 | 15.99911 | 5.552997 |
| 1972 | 3.457650 | 4.035014 |
| 1973 | 5.402664 | 4.474929 |
| 1974 | 12.67439 | 5.321064 |
| 1975 | 33.96419 | 6.303719 |
| 1976 | 24.30000 | 5.969616 |
| 1977 | 15.08783 | 5.494587 |
| 1978 | 21.70925 | 5.857182 |
| 1979 | 11.70973 | 5.242303 |
| 1980 | 9.972262 | 5.082611 |
| 1981 | 20.81282 | 5.815137 |
| 1982 | 7.697747 | 4.825563 |
| 1983 | 23.21233 | 5.923943 |
| 1984 | 17.82053 | 5.660419 |
| 1985 | 7.435345 | 4.791163 |
| 1986 | 5.717151 | 4.530881 |
| 1987 | 11.29032 | 5.206025 |
| 1988 | 54.51122 | 6.776129 |
| 1989 | 50.46669 | 6.699127 |
| 1990 | 7.364400 | 4.781656 |
| 1991 | 13.00697 | 5.346841 |
| 1992 | 44.58884 | 6.575460 |
| 1993 | 57.16525 | 6.823615 |
| 1994 | 57.03171 | 6.821279 |
| 1995 | 72.83550 | 7.065639 |
| 1996 | 29.26829 | 6.155210 |
| 1997 | 8.529874 | 4.927427 |
| 1998 | 9.996378 | 5.085012 |
| 1999 | 6.618373 | 4.675792 |
| 2000 | 6.933292 | 4.721854 |
| 2001 | 18.87365 | 5.717640 |
| 2002 | 12.87658 | 5.336814 |
| 2003 | 14.03178 | 5.422332 |
| 2004 | 14.99803 | 5.488642 |
| 2005 | 17.86349 | 5.662819 |
| 2006 | 8.239527 | 4.893050 |
| 2007 | 5.382224 | 4.471182 |
| 2008 | 11.57798 | 5.231048 |
| 2009 | 11.53767 | 5.227579 |
| 2010 | 13.72020 | 5.399977 |
| 2011 | 10.84079 | 5.165623 |
| 2012 | 12.21701 | 5.284492 |
| 2013 | 8.475827 | 4.921117 |

| | | |
|---|---|---|
| 2014 | 8.057383 | 4.870866 |
| 2015 | 9.017684 | 4.982648 |
| 2016 | 15.69685 | 5.533999 |