INDUSTRIAL OUTPUT VOLATILITY IN NIGERIA: Causes and Consequences

Ebi, Bassey Okon

Lionel Effiom

Department of Economics, University of Calabar, Calabar

ABSTRACT

Empirical studies in Europe, America and Asia have shown overwhelming evidence in support of the view that more volatile financial development raises industrial output volatility. The pertinent question is, does this evidence hold in the context of a mono economy such as Nigeria, driven by exogenous oil prices and high macroeconomic policy volatility? Accordingly, this paper investigates whether industrial growth volatility is principally caused by volatility of financial sector development in Nigeria. Total industrial output volatility was decomposed into the effects of financial development volatility, fiscal volatility, trade openness volatility, and oil price volatility using the vector auto-regressive (VAR) mechanism. All volatility measures are standard deviations of the various variables. Results suggest that about 24 per cent of the variations in industrial output volatility are caused by industrial output volatility itself, about 5 per cent and 38 per cent by financial institutions and financial markets volatilities respectively, representing a sum of 43 per cent attributed to financial sector development volatility, while 28 per cent are caused by volatility in openness to international trade, 2 per cent by fiscal policy (government expenditure) volatility and about 4 per cent by oil price volatility. The estimates also suggest that, on the whole, about 32 per cent of volatility in Nigeria's industrial sector was associated with exposure to external shocks while 68 per cent was attributed to domestic factors (especially domestic capital market development). The implication of these results is that industrial output

instability is relatively determined more by volatility in the domestic financial sector, and less by oil price and other external related volatility. Hence, volatility in the domestic capital market raised a major concern. The consequence of high output volatility is underdevelopment, as evident in low investment and widespread poverty in Nigeria.

JEL classification: C23; E32, G2; O43

1. Introduction

A number of recent empirical studies conducted in Europe, America and Asia have shown overwhelming evidence in support of the view that more volatile financial development increases industrial output volatility (Francisco, Eduardo & Arturo, 2009; Huang, Fang & Miller, 2013; Wang, Wen & Xu, 2016; and Iftikhar and Abbas, 2016). The pertinent question is, does this evidence hold in the context of Nigeria with a mono economy, driven by exogenous oil prices and high macroeconomic policy volatilities? The structure of the Nigerian economy is typical of an underdeveloped country. The primary sector, in particular, the oil and gas sector, currently dominates the gross domestic product accounting for over 95 per cent of export earnings and about 85 per cent of government revenue. The industrial sector accounts for just 6 per cent of economic activity while the manufacturing sector contributed only 4 per cent to GDP in 2016. According to Bennett, Anyanwu and Kalu (2015), a country is said to be industrialized when at least one-quarter of its gross domestic product (GDP) is produced in its industrial sector. An industrial sector that does not contribute at least one-quarter of the country's GDP is widely viewed as a major challenge facing a country's economic development.

In Nigeria, financial reforms started in the late 1980s on the suggestion and financial support of the World Bank (WB). Financial markets and industrial growth at aggregate level have remained unstable since the 1980s (see figure 1). It is more likely that volatility in financial markets may adversely affect industrial growth and its volatility.

On the contrary, co-movements in trends as observed in figure 1 may not necessarily imply causality. A number of questions remain open. What are the main sources of industrial output volatility in Nigeria? How much of industrial

output volatility in Nigeria is attributed to external and domestic shocks? And what is the consequence of industrial output volatility? This paper sought to provide answers to these questions. The study is important in view of the fact that stability is one of the key macroeconomic challenges for sustainable economic growth and development that concerns governments, policymakers, market experts, corporate managers and financial analysts. A successful macroeconomic policy to stabilize or reduce output volatility depends on knowing the sources of such volatility.

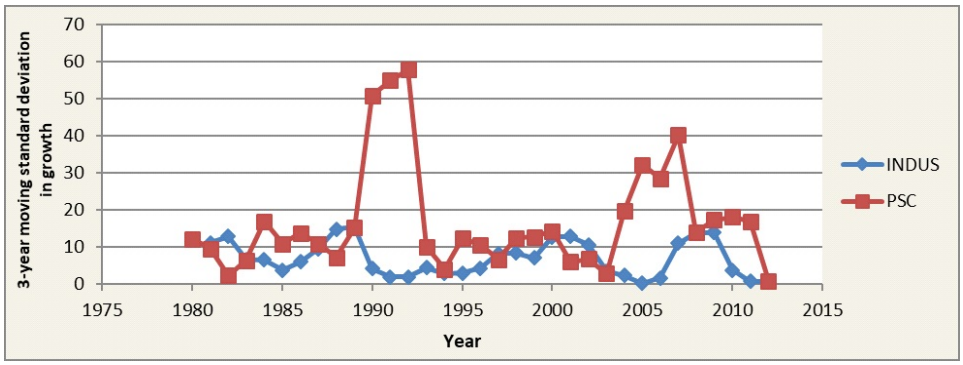

Figure 1. Trends in Industrial Output and Financial Development Volatilities.

Source: Author's computations based on data from *Central Bank of Nigeria statistical Bulletin, 2015*

The rest of this paper is organized as follows; section 2 reviews empirical literature on causes of industries' output volatility. Section 3 presents the data, its measurement and the methodology employed in this study. Section 4 presents empirical results. Section 5 discusses the implication and the consequences of the results and finally, section 6 concludes.

2. Empirical Literature Causes of Output Volatility

Rajan and Zingales (1998) assessed whether industries mostly dependent on external financing grow faster in countries with better developed financial institutions and markets. They showed that industries with a greater dependence on external financing grow faster in more financially developed countries.

Larrain (2006) and Raddatz (2006) implemented the methodology of Rajan and Zingales (1998), that is the, RZ model, to revisit the effect of financial development on industrial growth volatility, using cross-country, cross-industry (firm) data. Specifically, Larrain (2006) employed the RZ specification to examine whether better access to bank credit decreases or increases growth volatility. By regressing industrial volatility (the standard deviation of the detrended output of industry j in country k) onto the interaction of external dependence (in jth industry) and financial development (in kth country) along with other controls, Larrain (2006) found a significantly negative coefficient on the interaction term, arguing that lower volatility output occurs in sectors with higher external dependence and in countries with better financial development.

Raddatz (2006) used the same framework to investigate whether financial development leads to a larger reduction in output volatility in industries with high liquidity needs. By regressing industrial volatility onto the interaction between liquidity needs and financial development, Raddatz showed that financial development reduces the volatility of industries that require large amounts of liquidity. That is, financial development reduces growth volatility through external financial dependence.

Levchenko, Rancière and Thoenig (2008) analysed the effects of financial liberalization on growth and volatility at the industry level in a large sample of countries. They estimated the impact of liberalization on production, employment, firm entry, capital accumulation, and productivity. In order to overcome omitted variables concerns, they employed a number of alternative difference-in-differences estimation strategies. Financial liberalization was found to have a positive effect on both growth and volatility of production across industries.

Francisco, Eduardo and Arturo (2009) estimated the impact of financial development on industry-level total factor productivity (TFP) growth, using a largely unexploited panel of 77 countries with data for 26 manufacturing industries for the years 1963 to 2003. A significant relationship was obtained between financial development and industry-level TFP. They showed that TFP growth can accelerate up to 0.6 percent per year, depending on the external finance requirement of industries, following a one standard deviation increase in financial development.

Huang et al. (2013) investigated whether volatility of financial development plays a role in determining industrial growth volatility. Using an unbalanced panel data of 47 countries, their study pointed to three key findings; first, overwhelming evidence supports the view that more volatile financial development raises the industrial volatility in sectors that rely more on external liquidity. Second, the harmful effect of financial volatility on industrial volatility mainly works through the increase in fluctuations of the growth of real value added per firm and the number of firms, with the former effect being more prominent. Third, both the volatilities of the banking sector and the stock market positively associate with higher industrial growth volatility, which contrasts sharply with the finding in the existing literature that financial structure generally does not matter.

Iftikhar and Abbas (2016) investigated whether financial development volatility has effect on growth volatility of industries, using a panel data consisting of seven manufacturing industries listed on the Karachi Stock Exchange (KSE) in Pakistan, over the period 1994-2013. The results of their study revealed that financial development in the banking sector diminishes the growth volatility of industries that depend heavily on external liquidity. Whereas, banking sector volatility increases growth volatility of industries, the combined effect of both volatilities, banking sector and stock market, also results in growth volatility of industries.

Wang, Wen and Xu (2016) used the neoclassical growth model, with an endogenous financial market of credit arrangements and private debt, to show how financial development that promotes better credit allocations under more relaxed borrowing constraints can reduce the impact of non-financial shocks (such as TFP shocks, government spending shocks, preference shocks) on aggregate output and investment, and why this volatility-reducing effect diminishes with continuing financial liberalization.

Moore and Mirzael (2016) investigated the real effects of the 2007/2008 global financial crisis by using industry panel data across 82 countries. They found that industry growth indicators experienced a sharp drop following the crisis. However, a closer inspection indicated that the adverse effect was pronounced in industries that were more dependent on external financing, and also in those industries that relied on trade credit due to underdeveloped financial intermediation. It was also found that low- and lower-middle-income

countries tended to experience a less impact on growth. These findings provide new evidence of the negative externalities associated with credit market friction.

Claessens et al. (2012) examined how the 2007-2009 crisis affected firms' performance, using accounting data for 7722 non-financial firms in 42 countries. Claessens et al. analysed three channels through which the crisis may have affected firms: a business-cycle channel, a trade channel, and a financial channel. They found that the crisis had a bigger, negative impact on firms with greater sensitivity to business cycles and trade developments in countries more open to trade, while the evidence for the role of financial linkages is considerably weaker.

Yamamoto (2014) found that US spillover shocks, through both US financial and trade linkages, exert a significant impact on production in Asian economies, accounting for around 50 per cent of the production fluctuation with the impact of financial shocks being greater than that of trade shocks.

Some studies also suggest that in an economy open to international trade, an industry is more vulnerable to world supply and demand volatility. Giovanni and Levchenko (2008) examined the mechanisms through which industrial output volatility relates to trade openness and concluded that the relationship between trade openness and output volatility is positive and economically significant.

Using a cross-country panel of manufacturing and trade data, Adina, Miquel and Laura (2017) derived and estimated the components of industrial output volatility due to producer country-industry, and demand-specific shocks, and their interaction. They concluded that industrial output volatility is determined primarily by demand shocks. Those industries that are more open to trade are more volatile because intra-industry imports increase the uncertainty of domestic demand and production through a competition and a supply-chain effect respectively.

Riker and Thurner (2011) investigated the link between exporting and the economic stability of the US manufacturing sector by analysing industry-level shipments data for the US manufacturing sector from the Annual Survey of Manufactures and the Economic Census for the period 2000-2008. Their results revealed that industries with higher export shares experienced larger reductions in the volatility of their total outputs. While Fatás and Mihov (2012) found that fiscal policy volatility lowered output growth.

The main observation from these literature reviewed on industrial sector volatility as it relates to other sectors volatilities is that most of the studies are cross-country studies with a few country-specific, excluding Nigeria in both cases. Again, most of the studies, both cross-country and country-specific, supported the view that more volatile financial development raises brings about industrial output volatility. Hence, the main focus of this paper is to examine what causes industrial sector volatility in the context of Nigeria, which has a mono economy driven by exogenous oil prices and high macroeconomic policy volatilities.

3. Data, Measurement, and Method

3.1 Data and measurement

In line with Huang, Fang and Miller (2013) and Iftikhar and Abbas (2016), we measured industrial sector volatility (INDUS) by computing a three-year moving standard deviation of industrial output growth in Nigeria.

To measure financial development, given the complexity and dimensions it encompasses, empirical work done so far was usually based on available standard quantitative indicators, for instance, ratio of financial institutions' private credit to GDP, assets to GDP, ratio of liquid liabilities to GDP, and ratio of deposits to GDP (Global Financial Development Report, 2014). Since the financial sector of a country comprises a variety of financial institutions, markets and products, these measures only serve as a rough estimate and do not fully capture all aspects of financial development.

The World Bank's Global Financial Development Database (GFDD) developed a comprehensive and simple conceptual 4x2 framework to measure financial development worldwide. This framework identifies four sets of proxy variables characterizing a well-functioning financial system, namely: financial depth, access, efficiency, and stability. These four dimensions are then broken down for two major components in the financial sector, namely financial institutions and financial markets (see Global Financial Development Report, 2014 for details).

Given the focus of this research on industrial output, which involves firms' decisions, the most appropriate measure of financial development is the one that is closer to gauge the relaxation of firms' financial constraints. Therefore, we used the ratio of private credit by deposit money banks and other financial

institutions to GDP (PSC) over the 1980-2015 period as the primary measure of financial institutions development while stock market capitalization to GDP ratio (STOCK) was used to measure financial development in the context of financial markets. In line with Rajan and Zingales (1998), Larrain (2006), Raddatz (2006), Huang, Fang and Miller (2013), Wang, Wen and Xu (2016), and Iftikhar and Abbas (2016), we used the standard deviation of the ratio of private sector credit to GDP (PSC) as a measure of financial institutions' development volatility. Likewise, the standard deviations of stock market capitalization to GDP ratio (STOCK) measured financial markets development volatility.

The set of other variables includes volatility in government expenditure (GOV), trade openness (OPEN) measured by sum of export and import divided by GDP), and oil revenue (OIL). These are additional determinants of industrial volatility (Iftikhar & Abbas, 2016). All volatility measures are standard deviations of the various variables.

3.2 Method

To examine the causes of industrial sector output volatility in Nigeria, total industrial output volatility is decomposed into the effects of financial development volatility represented by standard deviations of the ratio of private sector credit to GDP (PSC) and stock market capitalization to GDP ratio (STOCK), fiscal volatility measured by volatility in government expenditure (GOV), trade openness (OPEN), and oil price volatility (OIL) using the vector autoregressive (VAR) mechanism.

The VAR model, unlike other models, does not necessarily impose restrictions on identifying the system. The VAR is particularly important because the variables are treated symmetrically in a structural sense with each variable having an equation explaining its evolution, based on its own lags and the lags of the other variables in the model. Also, no prior knowledge about the variables is required (Sim, 1980).

The VAR model is presented in a simultaneous system of equations as:

$$Y_t = C + \alpha(L)Y_{t\text{-}1} + U_t \quad (1)$$

where:

C is a vector of constant terms (C_1, C_2, C_3, C_4, C_5)

Y_t is the vector of the model variables (INDUS, PSC, STOCK, GOV, OPEN, OIL) as earlier defined in subsection 3.1

U_t is a vector of random disturbances

$\alpha(L)$ are matrices of coefficients in the lag operator L, to be estimated

4. Results of Causes of Industrial Output Volatility in Nigeria

Evidence regarding causes of industrial sector output volatility in Nigeria is obtained by generating impulse -response functions and variance decomposition from the VAR model. The moving average representation expresses each of the variables of the VAR system as a function of current and past disturbances. Using the coefficients of these disturbances or shocks, one can then trace out over time the response of any variable to a given shock to another variable. The entire time path of the affected variable is called an impulse response function. The impulse response function is shown in figure 3, while a more discerning test of causality based on the variance decomposition of a variable's forecast error variance is reported in table 1. The decompositions show the proportion of forecast error variance for each variable that is attributable to both its own volatility and those from the other variables. Thus, the relationship among the variables may be evaluated in terms of degree or percentage of causality as shown in table 1 and simplified in figures 2a to 2c. Table 1 is an extraction of variance decomposition of industrial output shocks/volatility (INDUS) alone in our VAR model.

Table 1. Variance Decompositions of Industrial Output Volatility (INDUS) from VAR Estimation

Period	S.E.	INDUS	PSC	STOCK	OPEN	GOV	OIL
1	2.914229	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	4.081922	74.52483	0.380855	23.21837	1.146152	0.635908	0.093886
3	5.904890	46.10366	2.609055	37.91862	9.116503	3.468586	0.783576
4	7.223655	31.12099	4.137907	40.07625	21.11408	2.864682	0.686094
5	7.649935	29.24728	3.758435	37.46486	26.20272	2.573997	0.752709
6	7.810824	28.80709	5.003662	35.95163	26.35301	2.623541	1.261063
7	7.868952	28.38350	5.621958	35.66514	26.16011	2.640459	1.528832
8	8.042768	27.99115	5.479901	36.50715	25.95562	2.527938	1.538244
9	8.414253	26.30745	5.571391	37.71947	26.64605	2.314682	1.440962
10	8.780977	23.95082	4.849214	37.70444	27.60687	2.144886	3.600004

Source: Author's estimation using VAR technique from e-view 9.0

From table 1, proportion of a 10-period variance explains that about 24 per cent of the variations in industrial output volatility (INDUS) is caused by industrial output volatility (INDUS) itself, while about 5 per cent and 38 per cent volatility in private sector credit to GDP (PSC) and stock market capitalization to GDP ratio (STOCK), representing a sum of 43 per cent is attributed to financial sector development volatility as illustrated in figures 2a and 2b respectively.

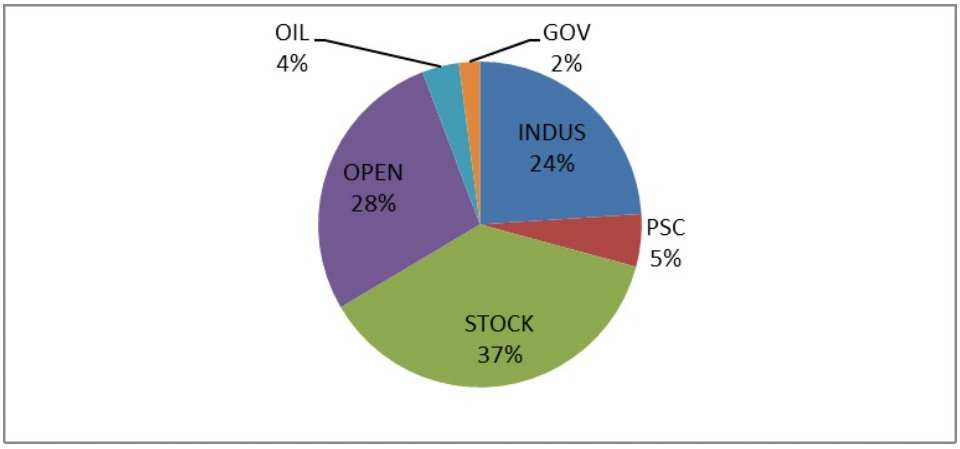

Figure 2a. Variance Decomposition of Industrial Output Volatility.

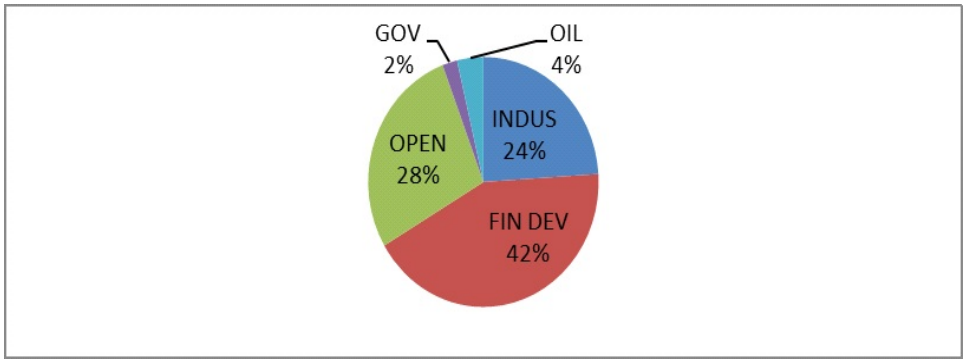

Figure 2b. Variance Decomposition of Industrial output Volatility with Emphasis on the Two Components of Financial Sector Development Volatility.

Figure 2a also reveals that about 28 per cent of industrial output volatility is caused by volatility in openness to international trade, 2 per cent caused by fiscal

policy (government expenditure) volatility and about 4 per cent attributed to oil price volatility.

To determine how much of Nigeria's industrial volatility is related to external or to domestic factors, we summed volatilities caused by trade openness and that of oil price to obtain volatility due to external factors, while the sum of volatilities due to the industrial sector itself, government spending, and financial sector development constituted volatility due to domestic factors. Estimates from figure 2c suggest that about 32 percent of volatility in Nigeria's industrial sector was associated with exposure to external shocks, and about 68 percent to domestic factors (especially insufficient domestic capital market development), was much more important. This finding is consistent with the increased importance attributed by policy makers to the development of domestic currency capital markets in developing economies like Nigeria.

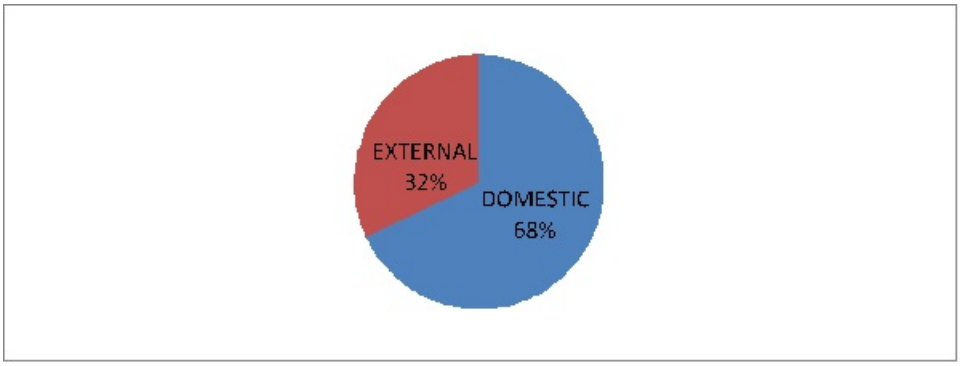

Figure 2c. Domestic and External Causes of Industrial Output Volatility.

Source: Author's computations based on results from table 1

Figure 3 is a combined impulse response function of industrial sector volatility to innovations in the industrial sector itself (INDUS), financial institution proxied by private sector credits (PSC), financial markets (STOCK), trade openness (OPEN), government expenditure (GOV) and oil price (OIL). The figure corroborates and reinforces the variance decomposition analysis, pointing out the fact that the industrial sector is more responsive to volatilities in itself and in stock markets as shown in wider fluctuations in their functions. The industrial sector was also negatively responsive to industrial sector itself and

in stock markets volatilities at first, in 4 and 3 years respectively, while in most of the later years, industrial sector volatility responded positively to innovations in these variables.

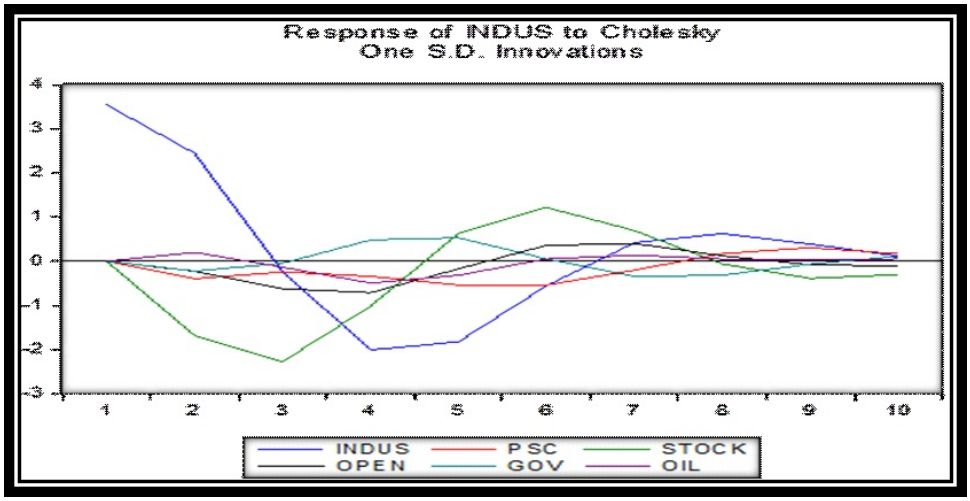

Figure 3. Combined Impulse Response Function

5. Implication of the Findings and the Consequence

Domestic financial markets have become a major priority for most developing countries. Some emerging market economies, including Chile, Mexico, South Africa, and some countries in Asia and Central Europe, have developed long-term and relatively low-cost domestic currency and currency swap markets and have managed to substantially eliminate currency mismatches and open exposures in the balance sheets of governments and large corporations. Sound market infrastructure reforms have been behind many of these success stories (Center for Global Development, 2008). But for Nigeria the road to efficient long-term domestic capital markets is likely to be long as evidenced by the volatility and low indexes of domestic capital market development.

In theory, integration with international markets should help smoothen out the effect of exogenous shocks on output, but as is shown in the results above, openness to international flows are highly procyclical and thus have been a part of the problem and the possibility of any global recession or meltdown hurting Nigeria's industrial sector cannot be ruled out.

The consequence of high output volatility is a development problem. Economists are especially concerned about high output volatility because it is closely associated with other negative aspects of underdevelopment. Unfortunately, the fact depicted in figures 2a to 2c indicates that neither financial markets nor domestic policies are helping to smooth industrial output in Nigeria.

A substantial body of technical literature has found evidence that high output volatility has negative effects on growth or is at least closely associated with lower growth (Fatás and Mihov 2006). This is not surprising as there is a broad consensus in the theoretical and empirical literature that high output volatility tends to depress investment (because investment flows depend on both expected rewards and risks) and to bias it toward short-term returns. Serven's (2002) work suggests that higher volatility is also associated with lower investment in human capital, for similar reasons.

Finally, several studies have shown that the speed of poverty reduction is a function of the rate of output growth. Thus, insofar as high volatility seems associated with both lower growth and higher inequality, it would appear to be a major drag on poverty reduction.

6. Conclusion

The paper investigates whether industrial growth volatility is principally caused by volatility of financial sector development in Nigeria. Total industrial output volatility was decomposed into the effects of financial development volatility, fiscal volatility, trade openness volatility, and oil price volatility using the vector autoregressive (VAR) mechanism. Results suggest that about 24 per cent of the variations in industrial output volatility is caused by industrial output volatility itself, while about 5 per cent and 38 per cent volatilities in private sector credit as a ratio of GDP (financial institutions) and stock market capitalization to GDP ratio (financial markets) respectively, representing a sum of 43 per cent, are attributed to financial sector development volatility. Further, 28 per cent of industrial output volatility is caused by volatility in openness to international trade, 2 per cent caused by fiscal policy (government expenditure) volatility and about 4 per cent is attributed to oil price volatility. The estimates also suggest that, on the whole, about 32 per cent of volatility in Nigeria's industrial sector is associated with exposure to external shocks, while 68 per cent is attributed to domestic factors (especially domestic capital market development). The

implication of these results is that industrial output instability is relatively determined more by volatility in the domestic financial sector, and less by oil price and other external-related volatility.

Volatility in domestic capital market raised a major concern. The consequence of high output volatility is underdevelopment, evident in low investment and widespread poverty in Nigeria.

References

Adina, A., Santa, C. and Miguel, L. (2017). *Volatility of Industrial Output, Demand Fluctuations, and International Trade.* Canterbury, UK: School of Economics, Keynes College, University of Kent.

Bennett, K.O., Anyanwu, U.N. and Kalu, A.U. (2015). The effect of industrial development on economic growth: Empirical evidence in Nigeria. *European Journal of Business and Social Sciences* 4: 127-140.

Center for Global Development. (2008). Causes and Consequences of High Volatility in Developing Countries. www.cgdev.org

Claessens, S. and Laeven, L. (2012). Financial dependence, banking sector competition, and economic growth. *Journal of the European Economic Association* 3: 179-207.

Fatás, A. and Mihov, I. (2006). Government size and automatic stabilizers: International and intranational evidence. *Journal of International Economics* 55: 3-28.

Fatás, A. and Mihov, I. (2012). Policy volatility, institutions and economic growth. *Review of Economics and Statistics* 95(2): 362-376.

Francisco, A., Eduardo, C. and Arturo, G. (2009). Financial Development and TFP Growth: Cross-country and Industry-level Evidence. *Inter-American Development Bank Working Papers 682.*

Giovanni, J. and Levchenko, A.A. (2008). Trade openness and volatility. *Review of Economics and Statistics* 91: 558-585.

Global Financial Development Report 2014. The World Bank.

Huang, H., Fang, W. and Miller, S.M. (2013). Does financial development volatility affect industrial growth volatility? *International Review of Economics & Finance* 29: 307-320.

Iftikhar, S.F. and Abbas, W. (2016). Does financial development volatility affect growth volatility of industries in Pakistan? *Econometrics Letters* (3)2: 15-27.

Levchenko, A.A., Ranciere, R. and Thoenig, M. (2008). Growth and risk at the industry level: The real effects of financial liberalization. *Journal of Development Economics* 89: 210–222.

Larrain, B. (2006). Do banks affect the level and composition of industrial volatility? *The Journal of Finance* 61(4): 1897-1925.

Moore, T. and Mirzael, A. (2016). The impact of the global financial crisis on industry growth. *The Manchester School* 84(2): 159–180.

Raddatz, C. (2006). Liquidity needs and vulnerability to financial underdevelopment. *Journal of Financial Economics* 80: 677-722.

Rajan, R. G. and Zingales, L. (1998). Financial dependence and growth. *American Economic Review* 88: 559-586.

Riker, D. and Thuner, B. (2011). The Impact of Exporting on the Stability of U.S. Manufacturing Industries. International Trade Administration's Manufacturing and Services Unit Brief No. 3. available at www.trade.gov/mas/ian.

Sims, C. (1980). Macroeconomics and reality. *Econometria* 48: 1-49.

Wang, P., Wen, P. and Xu, Z. (2016). Financial Development and Long-Run Volatility Trends. *Federal Reserve Bank of St. Louis Research Working Paper 2013-003B.*

Yamamoto, S. (2014). Transmission of US financial and trade shocks to Asian economies: Implications for spillover of the 2007–2009 US financial crisis. *North American Journal of Economics and Finance* 27: 88–103.