

*An Evaluation of Domestic Gas Utilization on the Nigerian Economy***ABSTRACT**

Natural gas has continued to experience high patronage over the years, largely due to its efficiency as an energy source. Economic growth literature posits that there is a relationship between energy consumption and growth. More recent literatures have argued for the efficiency of the form of energy used. The robustness of this relationship is however often questioned. Indeed natural gas remains one of the most efficient forms of energy source, and it is found in abundance in Nigeria with a proven reserve of over 180 trillion cubic feet of natural gas and the ninth country in the world in terms of proven natural gas reserves. Hence, given the significant outlays of natural gas to the economic growth, this study attempts an evaluation of domestic gas utilisation in Nigeria. Key macroeconomic variables with theoretical potential of influencing the level of gas utilized in Nigeria were subjected to econometric model testing using time series data from 1980 to 2013. The result in conformity with literature reflected that gas plays a pivotal role in the Nigerian economic advancement.

Keywords: Natural gas; Economic growth, Gas consumption, Capital, Labour, Domestic Utilization, Reserves.

1. INTRODUCTION

Natural gas is a fossil fuel formed when layers of buried plants and animals are exposed to intense heat and pressure over millions of years. Natural gas is the cleanest and most hydrogen-rich of all the hydrogen energy sources with high energy conversion efficiencies for power generation (Okologume, 2014).

Nigeria is among the world's top ten (10) countries in terms of natural gas proven reserves (over 180 trillion cubic feet (British Petroleum Statistics, 2014)), world's top five (5) exporters of liquefied natural gas (LNG) and a major supplier to the West African Gas Pipeline (WAPCo). Historically, there has been an over reliance on crude oil export and more search for oil than gas. However, with the continuous decline in global crude oil prices and increased demand for natural gas to fuel the power plants in the country. Natural gas is gaining more importance in Nigeria.

Nigeria started out primarily as an oil producing economy, sequel to the 1956 crude oil discovery in 1956. In the early days of the energy industry, the concurrent exploitation of associated gas was not taken into consideration to be worthy of pursuing because of the magnitude of revenue being generated from oil sales (Nwokeji, 2007). Although in more recent times, Nigeria is often referred to as a gas rich economy that produces oil (Okenabirhie, 2011). Nigeria is however, often cited as an example of how not to develop and manage a natural resource. Similar to most oil rich developing economies, Nigeria's economic development has been heavily dependent on the oil industry at the detriment of other sectors.

As at the 1960s, there were already calls for domestic gas utilization, however this was grossly hindered and impeded by infrastructural issues. On the other hand the country was in discussions with United Kingdom which were later delayed because price disagreement and before agreements were made there were North Sea discoveries which halted the process (Pearson 1970). However, after a couple decades of gas flaring, the Nigeria LNG company began operation in 1999 as part of export driven efforts to mitigate the environmental impacts of gas flaring and at the same time monetize Nigeria's gas deposits (Omisakin, 2011). With the commissioning of the West Africa Gas Pipeline (WAGP) in 2011, Nigeria commenced exporting gas to neighboring Ghana with plans to extend delivery to Benin and Togo as well (Shell 2011). While at the moment, gas is already been domestically utilized in generation of power for example, the initial export emphasis has led to a situation not too encouraging for effective domestic consumption and utilization.

In addressing this, the Nigerian government has instituted a domestic supply obligation (DSO) aimed at guaranteeing gas availability for local and domestic use as part of plans of deepening the domestic gas market and support industrialization. (Okenabirhie, 2011) identified fertilizer, aluminum, methanol as well as additional power plants as some of the available options proposed for deepening domestic gas market. In addition to guaranteeing domestic gas supply, a new pricing policy was adopted to encourage

domestic gas demand. The Nigerian government created the strategic domestic sector, strategic industrial sector as well as the strategic commercial sector as categories into which industries will be classified.

2. BACKGROUND OF THE STUDY

2.1.Trend Analysis of Key variables

Based on the analysis of natural gas consumption in Nigeria by the Unites States Energy Information Administration, natural gas consumption rose from 37.8 billion cubic feet in 1980 to 385.64 billion cubic feet in 2006 and then dropped to 190.7 billion cubic feet in 2011 while the gross domestic product(GDP) rose from 47.513 billion US \$ to 414.033 billion US \$.

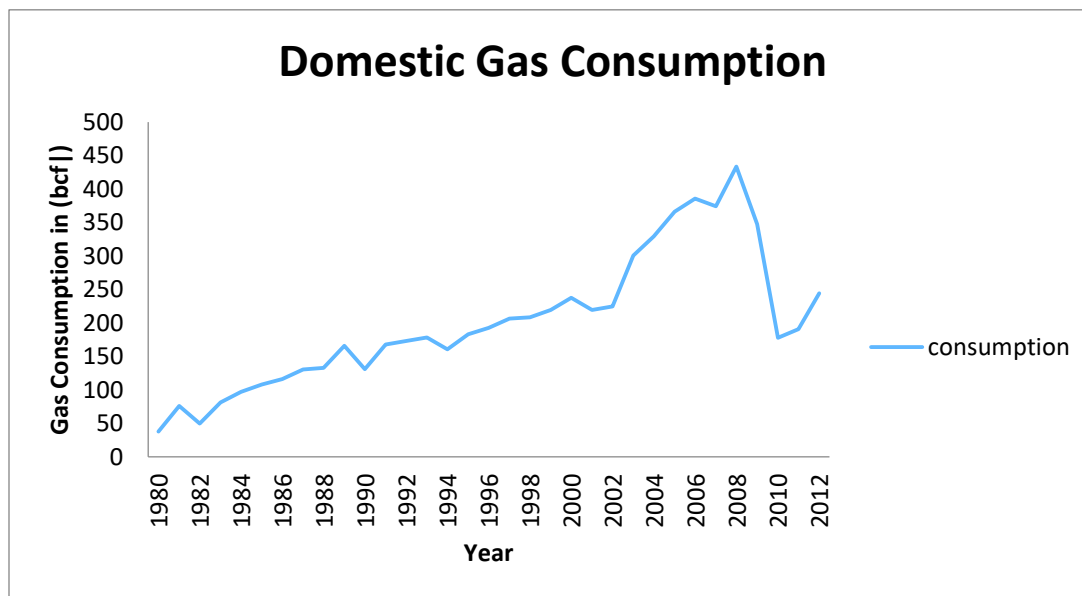


Figure 1: Domestic Gas Consumption in Nigeria (1980-2012)

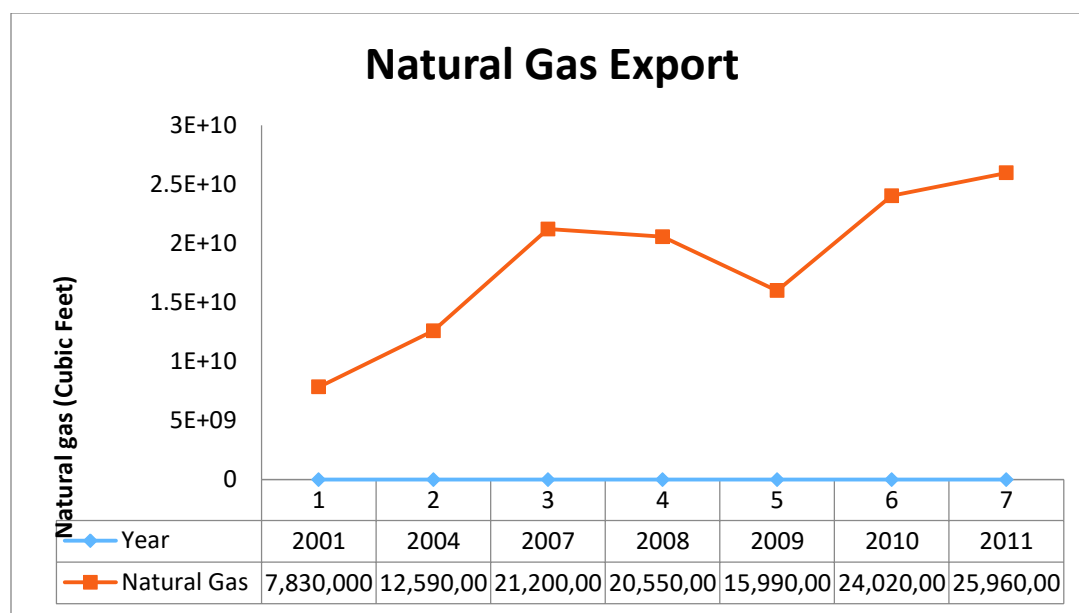


Figure 2 : Natural Gas Export in Nigeria (2001-2011)

2.2.Policy Developments

According to the National Energy policy, the following policies have been developed to encourage domestic utilization of natural gas. These are:

- The nation's gas resources shall be harnessed and optimally integrated into national economy, energy mix and industrial purposes.
- The nation shall engage intensively in gas exploration and development with a view to increasing the reserve base to the highest level possible
- The nation shall put in place necessary infrastructure and incentives to encourage indigenous and foreign companies to invest in the industry.
- The nation shall put in place necessary infrastructure and incentives to ensure adequate geographical coverage of the gas transmission and distribution network

POLICY/ REGULATIONS	OBJECTIVE
National Oil and Gas Policy 2004	In line with the National Energy Policy. Broad policy statements for petroleum industry, provides the policy frame work for a liberalized and functional gas industry, especially the domestic gas utilization
Downstream Gas Bill, 2005	Proposed to implement the liberalization of the domestic gas market.
Nigerian Gas Master Plan (NGMP) 2008	Domestic gas development agenda in line with the National Energy Policy and National Oil and Gas Policy. -Domestic gas supply obligation -Gas infrastructure blueprint -Gas Pricing Policy
National Domestic Gas Supply and Pricing Regulations 2008	Provides the framework for determining gas pricing across various sectors
Petroleum Industry Bill (PIB) 2012	Following the industry reforms that began in 2000, the PIB proposes a comprehensive legal framework for exploitation of petroleum, including gas.
Associated Gas Framework Agreement (AGFA) 1991 & 1992 and Sec. 39, Companies Income Tax Act 2007	Provide fiscal incentives for gas utilization-gas-fired power plants, GTL Plants, fertilizer plants, LNG, gas distribution and transmission pipeline.

The **Gas Aggregator Company of Nigeria (GACN)** was incorporated in 2010. It was created to manage domestic gas supply obligations volumes and to act as first point of contact for gas buyers to access gas for domestic market use.

The Gas Aggregator's Role

- engages in demand management until the end of Government's intervention through the domestic supply obligation.
- provides Aggregate Price / Securitization / Escrow Management services until the expiry of the first set of Gas Supply & Purchase Agreements.
- engages in gas network and system administration.
- a trading platform when the market is fully matures commercially and deregulated.

GAS VALUE CHAIN

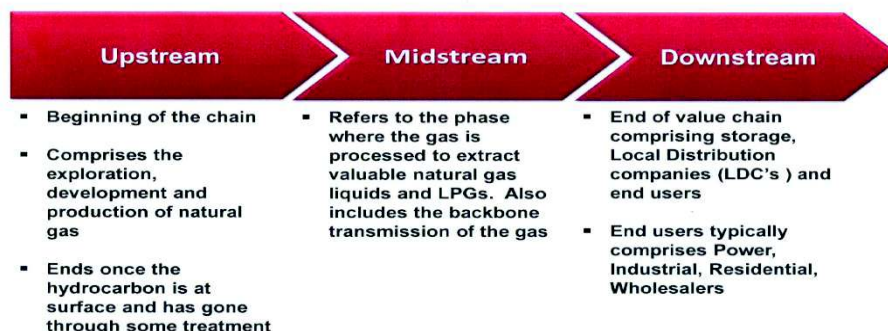


Figure 3: the Gas Value Chain in Nigeria

Source: Ige, D.2014

2.3.Challenges facing the Domestic Utilization of Natural Gas in Nigeria

Despite the growing importance of Natural gas in the country, some factors are hindering the optimal domestic utilization of gas, they include:

- Lack of adequate domestic supply infrastructure
- Unavailability of capital
- Regulated gas pricing
- Weak institutional structure for gas supply
- Pipeline vandalism
- Competition between the international and domestic markets

3. LITERATURE REVIEW

A number of studies have been published to evaluate the relationship between natural gas consumption and economic growth. Audu (2010) evaluated the relationship between gas utilization and the Nigerian economic performance using the error correction analysis; based on his findings he recommended that Nigerian gas sector should be fully utilized and policies should be made to attract foreign direct investment as well as full liberalization of the upstream and downstream sectors of the oil and gas industry. Okotie and Ikposo Assessed the economic cost of gas flaring in Nigeria using Empirical Method(t-test and correlation statistics), he study found that there is Significant wastage of the nation's income as a result of gas flaring in Nigeria. Ojide, et al., 2012, evaluated the impact and sustainability of gas utilization on the Nigerian economy using the distributed lag (DL) model, dummy variable regression model and co-integration analysis, he however found that Utilization of Nigerian natural gas impacts positively on the economy and it is sustainable. Adegbemi, et al (2013) carried out an Evaluation of the causal nexus between energy consumption and Nigeria's economic growth using the co-integration and ordinary least square technique, the empirical results reveal that petroleum, electricity and the aggregate energy consumption have significant and positive relationship with economic growth in Nigeria. The study also reveals that although gas consumption was positive, it does not have a significant effect on economic growth. Soheila and Nikos (2012) conducted a study to determine the causality relationship between Natural gas consumption and Economic growth in Iran using the Auto regressive distributed lag bounds

testing approach, results indicated that natural gas consumption, capital formation, employment, financial development, exports are contributing factors to domestic production and economic growth in Iran. Sahib et al (2014) carried out a study to determine the causality relationship between Natural gas consumption and Economic growth in France, using Cobb-Douglas Production function. Their findings indicated that natural gas consumption, capital, labour and exports are contributing factors to domestic production and economic growth in France. Demko (2010) investigated the type of causality between natural gas consumption and Regional economic growth in Ukraine using the Arellano Bond estimator; he however found out that there is a Positive impact of natural gas consumption on regional economic growth was found.

4. METHODOLOGY

Data used in the study is taken from World Development Indicators as well as the International Energy Statistics covering 1980-2013. For the study, Gas consumption is measured in Billion Cubic Feet, Labour is measured in millions, and economic growth is proxied to real GDP, while gross capital formation is used as a measure of investment in the economy.

This research adapts the Aqeel and Butt (2001) model which examines the impact of energy consumption on economic growth in Pakistan. For the purpose of this research, the model will relate only to gas consumption on economic growth in Nigeria. The general form of the model is set as:

$$Y = f(K, L, G) \quad \dots\dots\dots (1)$$

Where

Y = Real Gross Domestic Product (Dependent variable)

L = Labour

K = Capital (Investment)

G = Gas consumed

We have transformed all the series into logarithmic form. The logarithmic specification of Eq.(1) is as follows:

$$\log Y = \alpha + \beta_1 \log Lt + \beta_2 \log Kt + \beta_3 \log Gt + \varepsilon_t \quad \dots\dots\dots (2)$$

$\beta_1, \beta_2, \beta_3$ = are the elasticity of each of the independent variable.

log denotes logarithms, t denote time, β parameter value and ε denote the residual term. Logarithmic specification produces a better result compared to the linear functional form of the model. Thus, all data are transformed to natural logarithms.

4.1. RESULT AND ANALYSIS

Table 1: Descriptive Statistics

<i>Descriptive</i>	LY	LK	LL	LG
Mean	25.04306	22.80964	17.35353	5.179439
Median	24.85338	22.55683	17.38903	5.230861
Maximum	25.93444	23.81108	17.80818	6.071873
Minimum	24.50055	21.91424	16.81343	3.632045
Std. Dev.	0.444740	0.534701	0.289630	0.565544
Skewness	0.811388	0.510725	-0.264887	-0.768539
Kurtosis	2.158714	1.982045	1.970118	3.514385
Observations	34	34	34	34
<i>Correlation</i>	LY	LK	LL	LG
LY	1.000000	0.657126	0.856967	0.632668
LK	0.657126	1.000000	0.261510	-0.039724
LL	0.856967	0.261510	1.000000	0.875784
LG	0.632668	-0.039724	0.875784	1.000000

Table 2 : Unit Root Test

	Level		First differencing		Status
Variable	t-Statistic	Prob. Value	t-Statistic	Prob. Value	
LY	-2.470905	0.3393	-3.804243	0.0004	I(1)
LK	-3.377706	0.0735	-5.699182	0.0003	I(1)
LL	-3.403183	0.0180	-3.403183	0.0019	I(0)
LG	-3.002335	0.0450	-3.002335	0.0053	I(0)

Table 3: Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	10.43125	NA	7.86e-06	-0.401953	-0.218736	-0.341222
1	186.0621	296.3771*	3.69e-10*	-10.37888*	-9.462796*	-10.07522*
2	191.6601	8.047092	7.45e-10	-9.728755	-8.079802	-9.182173

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

4.2. Co-integration Test

The co integration test signifies if a long run relationship exists between the variables of the model, and therefore a signal for causality (Engle and Granger, 1987; Hendry, 1986; Gujarati and Porter, 2009).

Based on the results we conclude that long run relationship exists among the variables, as presented in Table 4 below.

Table 4: ARDL Cointegration Test

	LY	LG	LL	LK
LY(-1)	1.031790 (0.21069) [4.89722]	0.846143 (0.59500) [1.42209]	0.037852 (0.02688) [1.40796]	0.187942 (0.67190) [0.27972]
LY(-2)	-0.112202 (0.21505) [-0.52174]	-0.635229 (0.60732) [-1.04595]	0.004819 (0.02744) [0.17581]	0.785887 (0.68582) [1.14591]
LG(-1)	0.104194 (0.07222) [1.44284]	0.435645 (0.20394) [2.13815]	-0.004097 (0.00921) [-0.44462]	0.142953 (0.23030) [0.62073]
LG(-2)	-0.070496 (0.06231) [-1.13142]	0.048039 (0.17596) [0.27301]	-0.001809 (0.00795) [-0.22754]	-0.023732 (0.19870) [-0.11943]
LL(-1)	-0.242714 (1.75237) [-0.13851]	0.483764 (4.94880) [0.09779]	0.793621 (0.22361) [3.54920]	1.405737 (5.58845) [0.25154]
LL(-2)	0.391051 (1.67278) [0.23377]	0.046123 (4.72404) [0.00976]	0.141721 (0.21345) [0.66395]	-2.083064 (5.33465) [-0.39045]
LK(-1)	0.028815 (0.05746) [0.50151]	-0.314681 (0.16228) [-1.93931]	-0.001087 (0.00733) [-0.14825]	0.616825 (0.18324) [3.36626]
LK(-2)	-0.009781 (0.06858) [-0.14690]	0.042928 (0.18804) [0.22830]	-0.012993 (0.00850) [-1.52931]	-0.239195 (0.21234) [-1.12646]
C	-1.129031 (1.69327) [-0.66678]	-5.574588 (4.78190) [-1.16577]	0.440120 (0.21606) [2.03699]	0.890023 (5.39998) [0.16482]
R-squared	0.985007	0.895101	0.999290	0.874146
Adj. R-squared	0.979791	0.888615	0.999043	0.830371
Sum sq. resids	0.095498	0.761626	0.001555	0.971238
S.E. equation	0.064437	0.181973	0.008222	0.205494
F-statistic	188.8749	24.53235	4044.197	19.96892
Log likelihood	47.62417	14.40263	113.5071	10.51269
Akaike AIC	-2.414011	-0.337658	-6.531692	-0.094543
Schwarz SC	-2.001773	0.074580	-6.119454	0.317695
Mean dependent	25.05956	5.254317	17.38615	22.75345
S.D. dependent	0.453278	0.483955	0.265720	0.498940
Determinant resid covariance (dof adj.)		2.76E-10		
Determinant resid covariance		7.38E-11		
Log likelihood		191.6601		
Akaike information criterion		-9.728755		
Schwarz criterion		-8.079802		

To empirically analyze the long-run relationships and dynamic interactions among the variables of interest, the model has been estimated by using the bounds testing (or autoregressive distributed lag (ARDL)) co integration procedure, developed by Pesaran et.al (2001). The procedure is adopted for the following three reasons. Firstly, the bounds test procedure is simple. As opposed to other multivariate co integration techniques such as Johansen and Juselius (1990), it allows the co integration relationship to be estimated by OLS once the lag order of the model is identified. Secondly, the bounds testing procedure does not require the pre-testing of the variables included in the model for unit roots unlike other techniques such as the Johansen approach. It is applicable irrespective of whether the regressors in the model are purely I (0), purely I (1) or mutually co integrated. Thirdly, the test is relatively more efficient in small or finite sample data sizes as is the case in this study. The procedure will however crash in the presence of I (2) series. We have however ascertained that all our variables are strictly within I (1) and I (0).

While Engle Granger Co integration test is largely suitable for bivariate models, Johansen Co integration test requires a large set of observation. We have however opted for an ARDL co integration test because of the short nature of our observations and the mixed order of integration (I (0) and I (1)) of our variables.

4.3. Wald Test

To validate our ARDL test, a Wald test was conducted.

Table 5: Wald Test

Test Statistic	Value	df	Probability
F-statistic	2.831087	(4, 20)	0.0520
Chi-square	11.32435	4	0.0232

Null Hypothesis: $C(9)=C(10)=C(11)=C(12)=0$

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(9)	-0.562868	0.202819
C(10)	0.786778	0.450899
C(11)	-0.510641	0.215877
C(12)	-0.216391	0.600411

Restrictions are linear in coefficients.

The result of the Wald test reveals that coefficients are statistically different from zero with p values suggesting 5%; we therefore reject the null hypothesis and conclude that there is a long relationship among the variables.

4.4. Vector Error Correction Model

Table 6: Vector Error Correction Model

Cointegrating Eq:	CointEq1
LY(-1)	1.000000
LG(-1)	-0.593176 (0.22501) [-2.63626]
LK(-1)	-0.314015 (0.09893) [-3.17399]
LL(-1)	-1.373199 (0.43317) [-3.17010]

C	9.051967			
Error Correction:	D(LY)	D(LG)	D(LK)	D(LL)
CointEq1	-0.086828 (0.05142) [-1.68859]	0.175870 (0.16482) [1.06706]	-0.398457 (0.21408) [-1.86124]	0.021042 (0.00698) [3.01444]
D(LY(-1))	0.116968 (0.17408) [0.67194]	0.671183 (0.55796) [1.20292]	0.504052 (0.72474) [0.69550]	0.015356 (0.02363) [0.64979]
D(LG(-1))	0.061965 (0.04900) [1.26452]	-0.230039 (0.15707) [-1.46457]	0.132464 (0.20402) [0.64928]	0.007244 (0.00665) [1.08887]
D(LK(-1))	0.002911 (0.05332) [0.05459]	-0.217126 (0.17092) [-1.27033]	-0.123464 (0.22201) [-0.55612]	0.010794 (0.00724) [1.49113]
D(LL(-1))	-0.410398 (1.55752) [-0.26349]	-0.342580 (4.99228) [-0.06862]	5.038834 (6.48448) [0.77706]	-0.088657 (0.21144) [-0.41930]
C	0.043308 (0.04855) [0.89205]	0.039674 (0.15561) [0.25495]	-0.180723 (0.20213) [-0.89411]	0.031777 (0.00659) [4.82141]
R-squared	0.337699	0.269075	0.226742	0.392581
Adj. R-squared	0.210334	0.128512	0.078038	0.275769
Sum sq. resids	0.095808	0.984307	1.660667	0.001766
S.E. equation	0.060703	0.194571	0.252729	0.008241
F-statistic	2.651420	1.914269	1.524789	3.360805
Log likelihood	47.57237	10.29882	1.930229	111.4735
Akaike AIC	-2.598273	-0.268676	0.254361	-6.592091
Schwarz SC	-2.323447	0.006149	0.529186	-6.317266
Mean dependent	0.038301	0.039097	-0.003955	0.029946
S.D. dependent	0.068311	0.208424	0.263207	0.009683
Determinant resid covariance (dof adj.)	4.27E-10			
Determinant resid covariance	1.86E-10			
Log likelihood	176.8479			
Akaike information criterion	-9.302992			

5. CONCLUSION

In conclusion, based on the analysis conducted in this study, it was observed that there is a long run positive relationship between economic growth and gas consumption. Also there is a long run relationship between Gas consumption and labour, a long run inverse relationship between Gas Consumption and Investment in Nigeria, which shows the harsh investment environment of Nigeria. It is recommended that domestic demand for natural gas should be given priority over exportation and government should make the business environment friendly to attract foreign investment which will require review of some fiscal policies.

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