

China's economic policy uncertainty and trade flows between China and her six largest trading partners in Sub-Saharan Africa: an asymmetric analysis

Journal of
Chinese
Economic and
Foreign Trade
Studies

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Abstract

Purpose – The purpose of this study is to investigate how China's economic policy uncertainty (CEPU) affects trade dynamics between China and Sub-Saharan Africa (SSA). This is particularly critical given that China has surpassed the USA to become Africa's leading trade partner.

Design/methodology/approach – Using a nonlinear autoregressive distributed lag framework, the study investigates the asymmetric effects of CEPU on trade with six selected SSA economies – South Africa, Nigeria, Kenya, Angola, Tanzania and Ghana – over the period 2000Q1 to 2022Q4. The authors also analyse the asymmetric impact on imports from China into these economies.

Findings – The study finds that in the long run, both rising and declining CEPU levels promote Chinese trade with Kenya, Ghana and Tanzania, though only Ghana sees significant import gains. In the short run, rising and declining CEPU similarly tend to boost trade flows from China. However, only rising CEPU exerts a significant positive effect on imports in Ghana, while the impact of declining CEPU on imports remains largely negligible. Policy implications arising from these findings were discussed.

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JEL classification – C22, D40, D80, F40, N15, N17



Journal of Chinese Economic and
Foreign Trade Studies
Emerald Publishing Limited
1754-4408
DOI 10.1108/JCEFTS-06-2025-0078

Originality/value – The study, unlike previous studies, examines how CEPU is influencing trade flows between China and her six largest trading partners in SSA. It also investigates whether these trade flows respond asymmetrically to increases and decreases in CEPU.

Keywords Economic policy uncertainty, Exports, Asymmetric effect, Sub-Saharan Africa, China

Paper type Research paper

1. Introduction

Over the past three decades, one of the most important developments in the global economy is the rising influence of China in the global trading system ([Congressional Research Service, 2019](#)). According to statistics from [International Monetary Fund \(IMF\) \(2025\)](#), goods imports from China to other parts of the world rose from 4% to 15% between 2000 and 2024. This underscores its influence as one of the world's largest exporters of raw materials, minerals, intermediate inputs and other goods. Presently, China is Africa's largest trading partner, largest credit provider and major source of foreign direct investment ([Jenkins, 2022](#)). According to [IMF \(2025\)](#) statistics, China surpassed the USA as Africa's largest trade partner in 2009. In 2013, 22% of the region's overall trade came from China. In fact, China alone accounts for 19% of African imports in 2024, up from 4% in 2000. The US share, on the other hand, dropped from 8% in 2000 to 5% in 2024. In the same year 2024, China also accounted for 11% of African exports compared to 5% achieved by the USA. These statistics clearly indicate that China's trade roles in Africa have since outstripped that of the USA, and herein lies one of the key motivations for choosing China for this study.

The strong economic ties between China and SSA nations implies that the latter will be affected by China's economic policy uncertainty (CEPU). For instance, global trade uncertainty induced by the China-US trade war led to drop in commodity prices, unexpected tariff hikes, drop in major stock markets and deterioration in local currencies, with spillover effects in African countries, which are predominantly import-dependent ([Devermont and Chiang, 2019](#); [Phan et al., 2024](#)). Again, the high level of uncertainty induced by the novel Coronavirus Disease (COVID-19) pandemic, which originated from China, led to drastic fall in trade volumes across Africa. In response to the crisis, several countries in the region implemented lockdown measures and restrictions on economic activity. According to the UNCTAD Statistics, Africa experienced a more severe trade decline as a result of the COVID-19 pandemic than any other region. Due to their continued reliance on exports to other parts of the world, African nations are especially susceptible to disruptions like COVID-19 in international trade routes. As a result, they now have to deal with much greater trade and transportation costs. By 2024, shipping rates in Africa were twice as high as the average costs in 2023 and had risen to 115% above pre-COVID-19 levels [[United Nations Conference on Trade and Development \(UNCTAD\), 2025](#)].

In an attempt to stabilize African economies, these unanticipated challenges have forced African governments to constantly modify their economic policies, which has contributed to an increase in economic policy uncertainty (EPU) ([Baker et al., 2016](#); [An et al., 2023](#)). When economic agents are unable to forecast when or how government policies will change, EPU arises. Thus, there is a direct link between the trade performance of SSA countries and uncertainty emanating from China, with the expectation that such uncertainty can contribute significantly to the poor performance of these countries. Recently, the world has experienced so much uncertainty relating to trade. This has motivated this study to investigate how economic uncertainty originating from China is influencing trade flows between China and SSA countries. CEPU index in [Figure 1](#) aptly captures various uncertainty events that have had spillover effects in Africa.

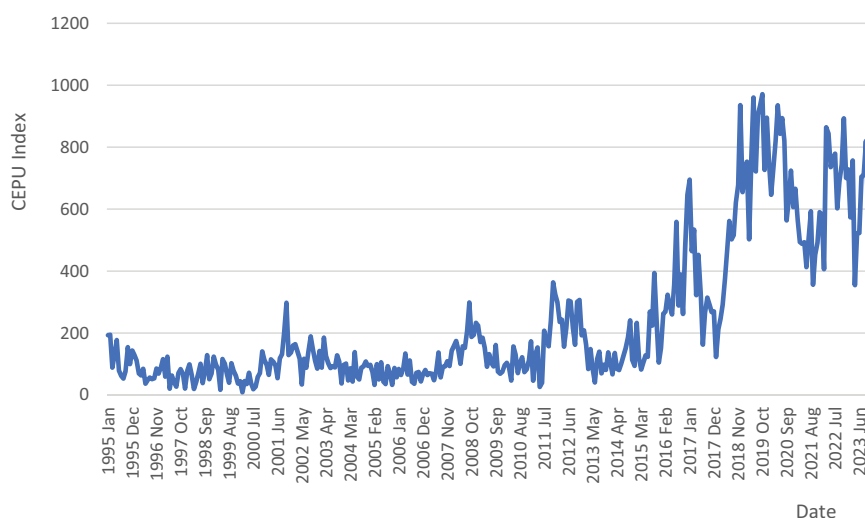


Figure 1. CEPU Index, January 1995–June 2023

It is interesting to note that some studies indicate that EPU may have a deterrent effect on an economy's development prospects since economic actors may act more cautiously during times of heightened uncertainty (Benigno and Groen, 2020). Novy and Taylor (2020) found that during uncertain times, businesses disproportionately reduce their orders for foreign supplies due to high costs, which can result in a large drop in trade flows. Consumers also tend to delay or suspend the purchase of non-essential goods during periods of high uncertainty, which affects overall economic activities and trade flows. Thus, the behaviour of economic agents both from the supply and demand sides of the economy indicate that uncertainty originating from a significant trade partner like China could have dire consequences on trade flows in SSA countries. Surprisingly, there is no empirical evidence regarding the asymmetric effect of China's policy uncertainty on trade between China and her trading partners in SSA economies. The few studies that are currently available on the macroeconomic effects of uncertainty on the continent, however, do not yet take into account the asymmetric effects of CEPU in a way similar to Shin *et al.* (2014). Since Bahmani-Oskooee and Nayeri (2018) have demonstrated that economic variables may react differently to a rise in policy-related uncertainty as opposed to a decline in policy-related uncertainty, this study aims to close a significant gap.

Given the background information mentioned above, this investigation brought up two significant questions. What is the pattern of the asymmetric effect of CEPU on trade flows between China and the selected SSA economies? What is the pattern of the asymmetric effect of CEPU on imports from China to the selected SSA economies? To answer these questions, the study applied the nonlinear autoregressive distributed lag (ARDL) methodology of Shin *et al.* (2014). The six SSA economies selected for this study are Angola, Ghana, Kenya, Nigeria, South Africa and Tanzania. These countries were selected because they are China's important trade partners in SSA, supplying raw materials, agricultural products and minerals to China, while also importing manufactured goods and technologies from China. In fact, they are predominantly resource-intensive economies that have extensive trade relations with China and account for over 55% of official bilateral debt to China from the region [World Trade Organization (WTO), 2021].

The rest of this study is planned in this way: in Section 2, the literature is reviewed. In Section 3, the study's methodology and data are presented. In Section 4, the empirical results are presented and discussed. And in Section 5, the paper's conclusion and policy recommendations are presented.

2. Literature review

2.1 Theoretical perspectives

This study is grounded in two key theories: uncertainty and international trade theories. One of the foundational trade theories is mercantilism, a country-focused classical approach that emphasizes achieving self-sufficiency through a favourable trade balance. It encourages countries to accumulate wealth and resources while maintaining positive trade balance. Hence, mercantilism is considered to be a form of economic protectionism because it maximizes exports and minimizes imports. In today's world, mercantilism is usually used to refer to economic policies limiting foreign goods imports, and famous economist, Adam Smith, used the term "trade system" to describe this political economic system aimed at enriching a country by restricting imports and encouraging exports (Smith, 1776). The theory of absolute advantage is another classical trade theory that is generally attributed to Smith (1776). The theorist challenged the commercial principles of mercantilism and argued in favour of a *laissez-faire* state. Smith explained that it is not possible, according to mercantilist theory, that all countries in the world can become rich at the same time as exports of one country are imports of another. Hence, he posited that all countries could benefit at the same time from free trade and the specialization that brings absolute advantages. The theory of comparative advantage is probably the most important concept in international trade attributed to Ricardo (1817). According to this theory, nations will focus on producing items in which they have a comparative advantage and then trade those goods with other nations so that trade benefits all parties. The theorist assumes that production technologies differ among nations.

Modern firm-based theories of trade also offer interesting interpretations of trends in international trade trends. For instance, the country similarity theory trade, which is attributed to Linder (1961), explains that nations with similar levels of economic development and preferences will engage in more intra-industry trade of similar but differentiated products. Hence, countries will export goods to neighbouring countries due to lower transportation costs and cultural similarities. According to the global strategic rivalry theory of trade, which first appeared in the 1980s, multinational firms will face international competition in their industries, and to thrive, they must create competitive advantages. Firms usually achieve competitive advantage by overcoming "barriers to entry" like owning intellectual property rights and gaining economies of scale, among others (Porter, 1980). The vent-for-surplus theory of international trade explains the process of expansion of foreign trade to less developed economies of Africa, South-East Asia and Latin America in the 19th century. The theory explains that developing nations usually have surplus of certain commodities, especially primary products, after meeting domestic demand and foreign trade gives value to these surplus products, thereby broadening the home market and providing a vent or outlet for the surpluses produced in the domestic market (Ranis, 1981). According to Tinbergen (1962) gravity model of international trade, foreign trade between nations is substantially impacted by factors like geographic closeness, economic size and parallels in consumer tastes and economic development.

Relevant theories of uncertainty in this study are the theory of real options channel, the theory of risk-premia and the Oi–Hartman–Abel effect. The theory of the real options channel, which dates back to Bernanke (1983), posits that firms have a number of real options for potential investments, and thus need to be cautious in making investment decisions during periods of high uncertainty since disembarking from investments comes at huge costs. Other

economic agents like consumers of durable goods also exercise caution during periods of rising uncertainty. The theory of risk-premia, according to Bloom (2014), explains that uncertainty slows down economic growth through rising risk premia, since uncertainty increases financing costs. Hence, investors will always demand for high compensation for taking high risk during periods of rising uncertainty. The Oi–Hartman–Abel effects explains that uncertainty can boost economic growth, since businesses could start growing and taking advantage of favourable outcomes, while contracts protecting them from unfavourable outcomes make them potential risk-takers (Hartman, 1972; Abel, 1983). This theoretical perspective emphasizes that uncertainty could have positive growth effect.

2.2 Recent empirical studies

Some recent empirical studies in Africa and other regions of the world have examined the effects of uncertainty using various methodologies with interesting results. Nana *et al.* (2024) used gravity model to study how uncertainty impacts on bilateral trade of 143 countries from 1980 to 2021. The study found that, in general, uncertainty deters trade. In the case of Africa, Ogbuabor *et al.* (2023a) used the system generalized method of moments (GMM) framework and a panel of 33 African economies to find that terrorism and uncertainty have significant negative effects on economic complexity. A recent study by Ogbonna and Ogbuabor (2025) found that rising uncertainty in China and Europe significantly hampers Africa's real sector, while the role of USA uncertainty is negligible. The study also showed that the financial sector in Africa benefits greatly from the uncertainties in China and Europe, indicating that investors can move their money to Africa as a safe haven from riskier areas with high levels of uncertainty. Using the system GMM approach, Ekeocha *et al.* (2023) discovered that domestic uncertainties and uncertainties from the UK, Japan, Russia and Europe had a negligible effect on African economic performance, whereas global uncertainties and uncertainties from the USA, China and Canada had a significant impact. Using similar methodological approach, Ogbonna *et al.* (2022) shown that foreign direct investment inflow into Africa is negatively impacted by global EPU and that African governance institutions exacerbate rather than mitigate this effect. The ARDL methodology was also used by Edeme *et al.* (2024) to demonstrate how global uncertainty substantially impedes Nigeria's economic growth over the long and short terms. Using the ARDL paradigm, Ogbuabor *et al.* (2021) discovered a steady and enduring correlation between the performance of the Nigerian stock market and the uncertainty surrounding economic policy. Market performance is severely hampered by EPU. According to Kumeka *et al.* (2023), Nigerian exchange market pressure is structurally independent of both domestic and international EPU. This decoupling is more noticeable during times of relative calm and adverse market developments. Recurrent adjustments in central bank policy, unforeseen adjustments in government policies, political meddling, unpredictable drops in global oil prices, economic recessions and unethical practices were all identified by Ozili (2022) as sources of EPU in Nigeria.

In an apparent methodological shift, Ogbuabor *et al.* (2023b) used the nonlinear ARDL framework to demonstrate that increasing world uncertainty hinders economic growth in Africa's oil exporters, while decreasing world uncertainty substantially improves growth. Similarly, Ogbonna and Ichoku (2022) examined the influence of oil price and exchange rate fluctuations on Nigeria's bilateral trade using an asymmetric adjustment approach. Their findings revealed that external shocks significantly affect Nigeria's trade balance, with exchange rate volatility amplifying the negative impact of oil price fluctuations. In a similar study, Ogbonna and Ichoku (2023) investigated whether the dynamics of the oil price and exchange rate have a symmetrical or asymmetrical impact on Nigeria's bilateral trade balance. Their results confirmed that asymmetric effects are prevalent, indicating that

Nigeria's trade balance deteriorates more significantly during periods of negative shocks than it improves during positive shocks. These findings reinforce the broader literature on uncertainty and trade, demonstrating that external volatility has non-linear and disproportionate effects on trade flows. Using the nonlinear ARDL model, [Bahmani-Oskooee and Nayeri \(2020\)](#) demonstrated that changes in the EPU had asymmetric short- and long-term effects on Japanese money demand. Using the same model, [Bahmani-Oskooee and Saha \(2019\)](#) demonstrated that EPU has asymmetric short- and long-term effects on share prices in Korea, Japan, the USA, Canada and the UK. The nonlinear ARDL approach is likewise used by [Rajput et al. \(2019\)](#) to demonstrate how uncertainty impacts foreign remittances asymmetrically in Brazil, India and Russia.

For studies that focused on countries outside Africa, [Ogbuabor et al. \(2023c\)](#) used nonlinear ARDL models to examine the asymmetric response of global retail energy markets to changes in EPU and crude oil prices. Rising uncertainty, according to the study, dramatically raises retail energy prices over the long and short terms, especially in the retail energy markets in the UK, Japan and Europe. [Alkan et al. \(2023\)](#) conducted a study to identify the extent of economic policy contagion between countries. The results showed that the EPU indices of The Netherlands and Ireland are more predictable with less randomness, while Greece and the UK have lower predictability compared to other countries. The impact of EPU on the trade flow of 143 nations was examined by [Borojo et al. \(2022\)](#), who discovered that exporting countries' trade volume is negatively impacted by high EPU in trade partner countries. The asymmetric impacts of EPU on real sector indicators in China, India, Brazil and South Africa were examined by [Ogbuabor et al. \(2024\)](#). The authors discover that decreasing uncertainty eventually slows the rise of both sectoral and aggregate output in these economies, which is contrary to economic expectations.

2.3 Research gap and hypothesis development

Clearly, an apparent gap in the literature is that the asymmetric impact of CEPU on trade between China and SSA countries is yet to investigate empirically. Given the critical role that Chinese trade plays in SSA economies, understanding how global EPU influences this trade flow dynamics is crucial for policymakers, businesses and other stakeholders. This study fills this gap in the literature to provide evidence and enhance understanding on how CEPU is influencing trade flows to this developing region. This is also important as it will further support development policymaking in the SSA region. In line with the specific objectives of this study and based on the theoretical aspects of the literature already highlighted, as well as prior empirical findings, we propose the following hypotheses expressed in their null form:

- H1. There is significant asymmetric effect of CEPU on trade between China and her six major trading partners in Sub-Saharan Africa.
- H2. CEPU has significant asymmetric effect on imports from China to top trade partners in Sub-Saharan Africa.

3. Data and methodology

3.1 The data

The data for this study consists of 92 quarterly observations from 2000Q1 to 2022Q4 for six Sub-Saharan African economies which include South Africa, Nigeria, Kenya, Angola, Tanzania and Ghana. These economies are largely resource-intensive and hold 55% of the region's official bilateral debt to China. There is a notable link between trade volumes and

loan disbursements between China and these countries, even when accounting for gross domestic product (GDP) [World Trade Organization (WTO), 2021].

The dependent variable in this study is imports from China (*IMPORT*), as well as total trade with China (*TRADE*), which captures the total volume of trade transactions between China and the selected SSA economies. This variable is used to assess how trade flows are influenced by external economic shocks and policy uncertainty (Ogbonna and Zerihun, 2025). The independent variable is CEPU. CEPU represents uncertainty in China economic policies and is expected to impact trade flows through changes in business confidence and investment decisions (Baker *et al.*, 2016). Given the role of exchange rate (EXR) in determining the relative price of traded goods, fluctuation in the exchange rate is captured in the study as a control variable and it is expected to influence the volume of trade between China and SSA economies (Ogbonna and Ichoku, 2022). Several other control variables are included to account for other macroeconomic factors that may affect trade volumes. Labour force participation (LFP) measures active workforce, which can influence production capacity and economic activity (World Bank, 2020). Real GDP per capita (RGDPPC) dynamics account for economic growth and income levels, which are fundamental determinants of trade demand (Ogbonna and Zerihun, 2025), while gross fixed capital formation (GFCF) represents investment in infrastructure and capital goods, which affect trade capacity and economic development (Borensztein *et al.*, 1998). Table 1 shows the data sources and adjustments.

The descriptive statistics of the variables are presented in Table A1 in the Appendix. Interestingly, all the variables showed considerable level of variation as seen from the standard deviations. We subjected all the variables to augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests and found that they are all stationary at first difference [i.e. integrated of order one, I(1)], except for GFCF that is stationary at level [i.e. I(0)] only in Angola. To preserve space, we do not display the unit root test results here, although they are

Table 1. Variable description and data sources

Variable	Description and unit of measurement	Data source
Total trade with China (TRADE)	Total trade is measured as exports plus imports in millions of US dollars	United Nations Comtrade Database
Total imports from China (IMPORTS)	Total imports measured in millions of US dollars	United Nations Comtrade Database
Labour force participation (LFP)	Labour force participation rate, total (% of population ages 15–64 years, modelled ILO estimate)	WB
Exchange rate (EXR)	Official local currency per US dollar (nominal exchange rate)	IMF International Financial Statistics
Real GDP per capita (RGDPPC)	Real GDP per capita measured in constant US dollars	WB
Gross fixed capital formation (GFCF)	Gross fixed capital formation, measured in percentage (%) of GDP	WB
China economic policy uncertainty (CEPU)	CEPU index	Baker <i>et al.</i> (2016) and the updates therefrom

Note(s): To ensure consistency across variables, inflation adjustment and exchange rate consistency were made. For inflation adjustments, all the monetary values were converted to constant US dollars using the consumer price index from the World Bank to control for inflationary effects. Bilateral exchange rates were converted into real effective exchange rates to account for currency fluctuations and maintain comparability over time. WB stand for World Bank’s World Development Indicators

Source(s): Authors’ own work

available upon request. Hence, all the variables meet the requirement of the nonlinear ARDL framework, which necessitates that the variables should be I(0) or I(1) or mutually cointegrated. The preliminary test results include the cointegration tests based on the t_{BDM} statistic of Banerjee *et al.* (1998) and the bounds testing approach of Pesaran *et al.* (2001). As we shall soon see, the variables have highly cointegrated at the conventional 5% level. We also subjected the asymmetric regressor in this study, which is the *CEPU* variable, to Brock, Dechert and Scheinkman (BDS) linearity test and the result indicates that the p -value is significant at 5% level, suggesting that this regressor is nonlinear. This is harmonious with the adoption of the nonlinear ARDL framework for this study. The BDS test results are presented in Table A2 in the Appendix. In line with this framework, we decomposed this regressor into partial sum processes of positive and negative changes in *CEPU* to capture the effects of rising and declining *CEPU* separately. This decomposition yielded 48% and 52% in favour of the positive and negative changes, respectively. Thus, we did not find any bias in favour of either regime in the data.

3.2 Methodology

The nonlinear ARDL framework was chosen for this study majorly because it captures the asymmetry in our presumed relationships. Traditional linear models assume that positive and negative changes in uncertainty have the same effect on trade. However, economic theory suggests that rising uncertainty may have a stronger effect than decreasing uncertainty. The nonlinear ARDL model allowed us to differentiate these effects (Shin *et al.*, 2014). The model effectively distinguishes between short-term fluctuations and long-term relationships, which is crucial given the lagged effects of policy uncertainty on trade (Bahmani-Oskooee and Fariditavana, 2016). In addition, given the relatively limited number of quarterly observations (92), the nonlinear ARDL framework is suitable because it performs well in small samples (Shin *et al.*, 2014; Pesaran *et al.*, 2001). To ensure the validity of the nonlinear ARDL model, pre-estimation tests were conducted. ADF and PP tests were used to verify that the variables satisfied the stationarity requirements of the model (Dickey and Fuller, 1981; Phillips and Perron, 1988). Bounds tests for cointegration was used to confirm that a long-run relationship exists between the variables following Pesaran *et al.* (2001). Post-estimation diagnostics were conducted to verify model adequacy. Breusch–Godfrey serial correlation test ensured that the error terms are not auto-correlated (Breusch, 1978; Godfrey, 1978), while the Breusch–Pagan heteroskedasticity test confirmed that the error variance is constant, ensuring reliable standard errors and inference (Breusch and Pagan, 1979).

Recall that the first specific objective of this study is to examine the asymmetric effect of *CEPU* on trade between China and the selected SSA economies. To achieve this objective, we followed Shin *et al.* (2014) and other established studies in the literature, such as Ogbuabor *et al.* (2023b), Ogbuabor *et al.* (2023c) and Ogbuabor *et al.* (2024), by specifying a nonlinear ARDL trade model in its error correction form as follows:

$$\begin{aligned}
 \Delta Intrade_t = & ptrade_{t-1} + \alpha^+ CEPU_{t-1}^+ + \alpha^- CEPU_{t-1}^- + \beta_1 EXR_{t-1} + \beta_2 GFCE_{t-1} \\
 & + \beta_3 LFP_{t-1} + \beta_4 RGDPPC_{t-1} + \sum_{j=1}^{p-1} y_j \Delta trade_{t-j} \\
 & + \sum_{j=0}^{q-1} \left(\pi_j^+ \Delta CEPU_{t-j}^+ + \pi_j^- \Delta CEPU_{t-j}^- \right) + \sum_{j=0}^{q-1} \left(\gamma_{1j} \Delta EXR_{t-j} \right) \\
 & + \gamma_{2j} \Delta GFCE_{t-j} + \gamma_{3j} \Delta LFP + \gamma_{4j} \Delta RGDPPC_{t-j} + e_t
 \end{aligned} \tag{1}$$

where $CEPU_t^+$ and $CEPU_t^-$ are the positive and negative partial sum decomposition of the $CEPU$ variable and other variables are as earlier defined. ρ is the speed of adjustment, while e_t is the error term that is expected to be homoscedastic and serially uncorrelated. α^+ and α^- are the long-run coefficients that we use to compute the long-run asymmetric parameters of $CEPU_t^+$ and $CEPU_t^-$.

as follows: $\beta^+ = \frac{-\alpha^+}{\rho}$ and $\beta^- = \frac{-\alpha^-}{\rho}$.

For the second specific objective of the study, which seeks to evaluate the asymmetric effect of $CEPU$ on imports from China to the selected SSA economies, we also specify a nonlinear ARDL imports model in its error correction form as follows:

$$\begin{aligned} \Delta \text{Import}_t &= \rho \text{import}_{t-1} + \alpha^+ \text{CEPU}_{t-1}^+ + \alpha^- \text{CEPU}_{t-1}^- + \beta_1 \text{EXR}_{t-1} + \beta_2 \text{GFDCF}_{t-1} \\ &+ \beta_3 \text{LFP}_{t-1} + \beta_4 \text{RGDPPC}_{t-1} + \sum_{j=1}^{p=1} \gamma_j \Delta \text{import}_{t-j} \\ &+ \sum_{j=0}^{q-1} \left(\pi_j^+ \Delta \text{CEPU}_{t-j}^+ + \pi_j^- \Delta \text{CEPU}_{t-j}^- \right) + \sum_{j=0}^{q-1} \left(\gamma_{1j} \Delta \text{EXR}_{t-j} \right. \\ &\left. + \gamma_{2j} \Delta \text{GFDCF}_{t-j} + \gamma_{3j} \Delta \text{LFP} + \gamma_{4j} \Delta \text{RGDPPC}_{t-j} \right) + e_t \end{aligned} \quad (2)$$

where: the variables and the parameters are as earlier defined.

Several reasons justify the choice of the nonlinear ARDL framework for this study. Firstly, the underlying models in equations (1) and (2) are linear in parameters, and are thus easily estimable by ordinary least squares. Secondly, the framework accepts both I(0) and I(1) variables, which aptly reflects the features of the variables in this study. Furthermore, the framework allows the existence of cointegration to be easily tested using the bounds testing approach of Pesaran *et al.* (2001) and the t_{BDM} statistic of Banerjee *et al.* (1998). Besides, the framework allows for the null hypotheses of long-run symmetry ($H_0: \beta^+ = \beta^-$) and short-run additive symmetry ($H_0: \sum_{j=0}^{q-1} \pi_j^+ = \sum_{j=0}^{q-1} \pi_j^-$) to be evaluated using Wald coefficient restriction tests.

4. Empirical results and discussions

4.1 Nonlinear autoregressive distributed lag model results on the asymmetric effect of China economic policy uncertainty on trade between China and her six trading partners in Africa

The first specific objective is to ascertain the asymmetric effect of $CEPU$ on trade between China and the selected Sub-Saharan African economies. To achieve this objective, this study estimated equation (1). The results are presented in Table 2. Panel A of Table 2 reports the estimated long-run parameters based on the notations in equation (1), while Panel B reports the estimated short-run parameters. Panel C reports the symmetry tests, and Panel D reports the diagnostic checks.

The results in Table 2 show that in line with theoretical prediction, the speed of adjustment across all the countries bear negative coefficient and it is statistically significant even at 1% level. This coefficient shows the speed at which the system adjusts towards its long-run equilibrium after a shock. The speed of adjustment ranges between 15% and 74%, which is consistent with Ogbonna and Ichoku (2023) that found a statistically significant negative speed of adjustment. The speed of adjustment is nonetheless sluggish in most of the countries, particularly Nigeria, South Africa, Ghana and Tanzania, suggesting that the

Table 2. Nonlinear ARDL estimation results for asymmetric effect of CEPU on trade from China

Variable name	Nigeria	S. Africa	Kenya	Ghana	Angola	Tanzania
<i>Panel A – estimated long-run coefficients</i>						
ρ	-0.32***	-0.21***	-0.55***	-0.15***	-0.74***	-0.38***
β^+ (CEPU)	0.44	-0.18	0.01	0.01	-0.56	0.38***
β^- (CEPU)	-0.74*	0.15	0.47***	0.55	-0.78***	0.35*
Exchange rate	3.90**	3.08***	1.57***	0.31	-0.52***	1.85
Gross capital formation	6.52***	1.95	-0.82	1.24*	1.17***	-1.08
Labour force participation	101.53***	17.53	21.38***	-37.27*	6.14	14.49*
Real GDP	-6.89	-12.76*	0.17	-3.77	-7.19***	-7.21
<i>Panel B – estimated short-run coefficients</i>						
$\sum_{j=0}^q \pi_j^+$ (CEPU)	0.00	0.20**	0.20**	0.00	-2.68***	0.16**
$\sum_{j=0}^q \pi_j^-$ (CEPU)	0.00	0.00	0.15*	0.00	0.40**	0.00
$\sum_{j=0}^q \delta$ (exchange rate)	-4.77**	-0.16*	1.53***	-0.85***	-0.40**	-1.93***
$\sum_{j=0}^q \tau$ (gross capital formation)	1.97***	1.54***	0.93***	0.00	-1.73***	-0.97***
$\sum_{j=0}^q \psi$ (labour force participation)	110.17***	-7.60**	-34.84**	-94.88**	-50.46**	0.00
$\sum_{j=0}^q \omega$ (real GDP)	-3.78**	0.00	0.00	-5.38***	0.76**	0.00
<i>Panel C – symmetry tests</i>						
$\mathcal{H}_0 : \beta^+ = \beta^-$	8.01***	2.08	39.98***	1.23	12.52***	0.03
$\mathcal{H}_0 : \sum_{j=0}^q \pi_j^+ = \sum_{j=0}^q \pi_j^-$	0.00	4.74**	0.19	0.00	26.89***	4.25**
<i>Panel D – diagnostic tests</i>						
F _{PSS}	5.60***	3.80***	8.17***	2.67**	10.54***	7.39***
t _{BDM}	-4.60***	-3.43**	-6.83***	-3.00*	-8.35***	-3.58**
BG test (NR ²) (serial correlation)	10.28***	0.10	7.13**	0.38	2.40	0.07
BGP test (heteroscedasticity)	36.32***	26.74***	13.43	9.74	34.50*	10.39
R ²	0.60	0.44	0.77	0.54	0.73	0.75
Note(s): *, **and *** signify significance at the 10, 5 and 1% level, respectively. The symmetry tests results are derived from standard Wald tests. The BGP test stands for the Breusch–Pagan–Godfrey heteroscedasticity test, whereas the BG test stands for Breusch–Godfrey serial correlation test. F _{PSS} stands for the test statistic derived from the bounds testing approach established by Pesaran <i>et al.</i> (2001), while t _{BDM} denotes the test statistic that follows the cointegration test developed by Banerjee <i>et al.</i> (1998). The critical values associated with the t _{BDM} statistic are as follows: -2.91 at the 10 level, -3.22 at the 5 level and -3.82 at the 1% level						
Source(s): Authors' own work						

adjustment towards the long-run equilibrium following shocks to CEPU may be asymmetric. This is also consistent with the findings of Baker *et al.* (2016), which also obtained negative speed of adjustment associated with policy uncertainty.

The estimated long-run coefficients represent the equilibrium relationship between CEPU and trade from China to the respective Sub-Saharan African countries. The results in Table 2 indicate that rising CEPU mainly enhances trade from China in the long term; however, this effect is statistically significant only in Tanzania at the conventional 5% level. The results show that a unit increase in CEPU increases trade from China to Tanzania by 38%, which is consistent with Baker *et al.* (2016) and Bloom (2009). The results in Table 2 also show a clear pattern that in the long run, declining CEPU predominantly increases trade from China, and this relationship is significant in Kenya and Tanzania at the 5% level. This is consistent with Baker *et al.* (2016) and Bloom (2009), which also found that declining uncertainty fosters economic activities and trade among countries. Hence, we can conclude that in the long-term, both rising and falling CEPU enhance trade from China, especially in Kenya,

Ghana and Tanzania. The symmetry tests in Panel C indicate that there is significant long-run asymmetric influence of CEPU on trade from China in Nigeria, Kenya and Angola, which firmly justifies the choice of nonlinear ARDL approach.

The results become more exciting when we study the patterns of the short-term additive asymmetric effects of CEPU. The results in [Table 2](#) show that in the short term, both rising and falling CEPU predominantly enhance trade from China. The only exception to this finding is in Angola, where rising CEPU significantly deters trade from China. Hence, we conclude that CEPU mainly enhances trade from China to the selected SSA countries in the short term. This finding aligns with the results that decreasing uncertainty fosters economic activity and trade as documented by [Baker et al. \(2016\)](#) and [Bloom \(2009\)](#). This finding is also consistent with [Ogbuabor et al. \(2024\)](#), which obtained some positive effects of declining uncertainty on real sector variables. The symmetry tests in Panel C show that in the short run, there is significant asymmetric effect in South Africa, Angola and Tanzania. The patterns of this asymmetry in South Africa and Tanzania indicate that the response of trade from China to rising CEPU significantly higher than its response to declining CEPU. In the case of Angola, the patterns of this asymmetry indicate that the negative response of trade from China to rising CEPU significantly differs from its positive response to declining CEPU. These asymmetric patterns underline our choice of the nonlinear ARDL approach.

The impact of exchange rate fluctuation is primarily negative and significant in the short run, except in Kenya where its effect is positive. This suggests that except for Kenya, variations or fluctuations in the exchange rate significantly deter trade from China to all the selected SSA in the short term. This is consistent with [Abdulsalam and Onipede \(2022\)](#) and [Campa and Goldberg \(2005\)](#). However, the influence of exchange rate variation is not predominantly trade-retarding in the long run, indicating that fluctuations in the exchange rate is not a key deterring factor in the long run. In sum, we find that short-term fluctuations in the exchange rate significantly deter trade flows from China to majority of the SSA economies. This finding aligns with the findings on exchange rate pass-through and trade competitiveness as documented by [Campa and Goldberg \(2005\)](#) and [Goldberg and Campa \(2010\)](#).

The effect of GFCF is mainly positive both in the long run and short run. In the long run, its effect is positively significant in Nigeria, Ghana and Angola, while in the short run, its effect is positively significant in Nigeria, South Africa and Kenya. This indicates that GFCF in these countries is enhancing trade from China to these SSA economies. This finding is consistent with both classical and neoclassical growth theories that have identified physical capital stock as an important factor in the economic growth process. It supports the findings of [Ogbuabor et al. \(2023b\)](#), who demonstrated that capital plays a major role in the expansion of Africa's oil exporters. The finding is also consistent with the findings of [Bacchetta and van Wincoop \(2005\)](#) and [Flam and Helpman \(1987\)](#), which indicate that increased gross capital formation can lead to higher trade volumes.

The impact of LFP is somewhat mixed. In the long run, its effect is mainly positive and significant in Nigeria, Kenya and Tanzania. In the short run, its effect is mainly negative and significant in South Africa, Kenya, Ghana and Angola, thereby reflecting the high level of unemployment in these countries during the period under study. This negative effect of LFP is consistent with the findings of [Amiti and Davis \(2012\)](#), which documented that changes in labour market dynamics can affect short-run trade patterns. Its impact on real GDP per capita is primarily detrimental and substantial over the long and short terms, particularly in Ghana and Nigeria. This pattern is pronounced in South Africa, Angola and Tanzania in the long-run. This is a clear reflection of the poor economic growth performance of these economies, particularly during and after the COVID-19 pandemic. It is also consistent with the findings

of [Rose et al. \(2000\)](#), which established that economic growth fluctuations can lead to short-term variations in trade volumes.

At this point, we summarize the findings from the first specific objective of this study as follows. We find that:

- the speed of adjustment ranges between 15% and 74% but remained sluggish in most of the countries, suggesting that the adjustment of trade from China towards the long-run equilibrium following shocks to CEPU may be asymmetric;
- in the long term, both rising and declining CEPU enhance trade from China, especially in Kenya, Ghana and Tanzania;
- in the short run, both rising and declining CEPU predominantly enhances trade from China; and
- exchange rate fluctuation, LFP and real GDP per capita significantly hamper trade from China to most of these SSA economies, particularly in the short run, while GFCF is trade-enhancing.

From the diagnostic checks, the Breusch–Godfrey serial correlation tests indicate a problem of autocorrelation in Nigeria and Kenya, while the models for Nigeria and South Africa revealed the presence of heteroscedasticity at the 5% level. These problems were corrected using the Newey–West HAC standard errors, but the asymmetric patterns and the estimated coefficients remained consistent. The [Pesaran et al. \(2001\)](#) bounds test results and the t_{BDM} statistics showed the presence of equilibrium or cointegrating relationship among the variables in all cases. This is consistent with the choice of the underlying model, which we specified in its error correction form to capture both the equilibrium relationships and the short-run dynamics.

4.2 Nonlinear autoregressive distributed lag model results on the asymmetric effect of China economic policy uncertainty on imports from China

The second specific objective of this research is to estimate the asymmetric effect of CEPU on imports from China to the selected SSA economies. To accomplish this aim, this research estimated [equation \(2\)](#). The results are presented in [Table 3](#). In line with the established pattern, Panel A of the [Table 3](#) reports the estimated long-run parameters following the labelling of [equation \(2\)](#), while Panel B reports the estimated short-run parameters. Panel C reports the symmetry tests, and Panel D reports the diagnostic checks.

The results in [Table 3](#) show that in line with theoretical prediction, the speed of adjustment across all the countries bear negative coefficient, and it is statistically significant even at 1% level. This coefficient shows the speed at which the system adjusts towards its long-term equilibrium after a shock. The speed of adjustment ranges between 24% and 93%, which is consistent with [Ogbonna and Ichoku \(2023\)](#) that found a statistically significant negative speed of adjustment. The speed of adjustment is nonetheless sluggish in some of the countries, particularly South Africa, Kenya and Tanzania, suggesting that the adjustment towards the long-term equilibrium following shocks to CEPU may be asymmetric. This is also consistent with the findings of [Baker et al. \(2016\)](#), which also obtained negative speed of adjustment associated with policy uncertainty.

The estimated long-run coefficients represent the equilibrium relationship between CEPU and imports from China to the respective Sub-Saharan African countries. The results in [Table 3](#) show that the impact of CEPU is mixed in the long term. Rising CEPU significantly enhances imports from China in Ghana in the long run, while it deters imports in South Africa and Angola. Declining CEPU significantly enhances imports from China in the long-run in Ghana and Tanzania, while it deters imports in Angola. The only clear pattern observable from the

Table 3. Nonlinear ARDL estimation results for asymmetric effect of CEPU on imports from China

Variable name	Nigeria	S. Africa	Kenya	Ghana	Angola	Tanzania
<i>Panel A – estimated long-run coefficients</i>						
ρ	-0.73***	-0.31***	-0.30***	-0.82***	-0.93***	-0.24***
β^+ (CEPU)	0.58	-0.97**	0.68	0.96***	-0.66***	0.11
β^- (CEPU)	-0.50	0.47	-0.08	0.44*	-1.04***	2.02**
Exchange rate	2.92	4.91***	-2.30	-2.52***	-0.74***	-4.91
Gross capital formation	4.56***	-21.71***	-3.46	-0.12	1.66***	-5.60
Labour force participation	91.52***	111.12***	87.29***	-42.65***	15.35**	-24.05
Real GDP	-9.95*	7.52	-28.70**	-11.83***	-7.68***	33.08
<i>Panel B – estimated short-run coefficients</i>						
$\sum_{j=0}^q \pi_j^+$ (CEPU)	-1.12*	0.00	0.00	0.79***	-3.62***	-1.01***
$\sum_{j=0}^q \pi_j^-$ (CEPU)	0.00	0.00	0.00	0.00	0.52***	0.00
$\sum_{j=0}^q \delta$ (exchange rate)	-5.96***	0.00	4.07**	-3.57*	-0.60***	0.00
$\sum_{j=0}^q \tau$ (gross capital formation)	2.47*	-20.18***	0.00	2.57*	-2.90	0.00
$\sum_{j=0}^q \psi$ (labour force participation)	287.05***	80.20***	-11.81*	86.04**	-31.82**	2.95***
$\sum_{j=0}^q \omega$ (real GDP)	-11.68**	0.00	-1.02***	13.37***	-6.76***	0.00
<i>Panel C – symmetry tests</i>						
$\mathcal{H}_0 : \beta^+ = \beta^-$	4.03**	7.94***	2.17	4.74**	41.92***	5.79**
$\mathcal{H}_0 : \sum_{j=0}^q \pi_j^+ = \sum_{j=0}^q \pi_j^-$	3.43*	0.00	0.00	7.29***	32.79***	14.54***
<i>Panel D – diagnostic tests</i>						
F_{PSS}	6.96***	7.26***	3.01***	11.25***	13.88***	2.47**
t_{BDM}	-6.49***	-4.73***	-4.10***	-8.28***	-9.21***	-3.45**
BG test (NR ²) (serial correlation)	0.59	9.61***	7.88**	1.79	0.72	4.38*
BGP test (heteroscedasticity)	18.46	28.40***	39.43***	24.18**	45.91***	12.05
\bar{R}^2	0.49	0.48	0.44	0.58	0.71	0.50

Note(s): *, **and *** signify significance at the 10, 5 and 1% level, respectively. The symmetry tests results are derived from standard Wald tests. The BGP test stands for the Breusch–Pagan–Godfrey heteroscedasticity test, whereas the BG test stands for Breusch–Godfrey serial correlation test. F_{PSS} stands for the test statistic derived from the bounds testing approach established by Pesaran *et al.* (2001), while t_{BDM} denotes the test statistic that follows the cointegration test developed by Banerjee *et al.* (1998). The critical values associated with the t_{BDM} statistic are as follows: -2.91 at the 10% level, -3.22 at the 5% level and -3.82 at the 1% level

Source(s): Authors' own work

long-run effects of CEPU is that it maintained a muted impact in Nigeria and Kenya. Hence, we conclude that both rising and declining CEPU do not impact significantly on imports from China to Nigeria and Kenya. Nonetheless, the long-run symmetry tests in Panel C show that there is significant asymmetric effect of CEPU on imports from China in all cases, except for Kenya. This demonstrates why the nonlinear ARDL approach was used for this investigation.

The results are definitely more fascinating when we examine the patterns of the short-term additive asymmetric effects of CEPU on imports from China. This is because a clear pattern emerges on the responses of imports to both rising and declining CEPU. The results in Table 3 show that in the short run, rising CEPU predominantly deters imports from China. The only exception to this finding is in Ghana where its positive effect is significant and South Africa and Kenya where its effect is muted. However, the impact of falling CEPU remained muted throughout, except for Angola where its effect is positive and significant. Hence, we conclude that while rising CEPU predominantly deters imports, the effect of declining CEPU is mainly negligible. This deterring effect of rising CEPU is consistent with Ekeocha *et al.* (2023), which demonstrated that there is a statistically significant negative

relationship between increasing China policy uncertainty and economic performance in Africa. The short-term symmetry tests in Panel C show that in the short term, only Ghana, Angola and Tanzania exhibit a substantial asymmetric impact. The patterns of this asymmetry in Ghana indicates that the response of imports from China to rising CEPU is significantly higher than its response to declining CEPU. In the case of Angola and Tanzania, the patterns of this asymmetry indicate that the negative response of imports from China to rising CEPU significantly differs from its response to declining CEPU.

The impact of exchange rate fluctuation is primarily detrimental and significant both in the long and short term. In the long term, its effect is negative in most of the countries and substantial in Ghana and Angola. In the short run, its effect is negative and significant in Nigeria, Ghana and Angola. This indicates that variations in the exchange rate substantially deter imports from China to most of the selected SSA economies both in the long and short term. This is consistent with [Abdulsalam and Onipede \(2022\)](#) and [Campa and Goldberg \(2005\)](#). In sum, we find that both long-term and short-term fluctuations in the exchange rate substantially deter imports from China to majority of the SSA economies. This finding aligns with the findings on exchange rate pass-through and trade competitiveness as documented by [Campa and Goldberg \(2005\)](#) and [Goldberg and Campa \(2010\)](#).

The effect of GFCF is somewhat mixed both in the long and short term. In the long run, its effect is significantly negative in South Africa and significantly positive in Nigeria and Angola. In the short run, its effect is significantly negative in South Africa and muted in other countries at the 5% level. Hence, we conclude that GFCF significantly deters imports from China only in South Africa both in the long run and short run. It is also a reflection of the low level of capital formation in SSA economies. This finding is also consistent with the understanding that domestic economic conditions can considerably influence trade flows as documented by [Helpman and Itskhoki \(2010\)](#).

The effect of LFP shows a clear pattern, which indicates that both in the long run and short run, LFP predominantly enhances imports from China. In the case of real GDP per capita, its effect also follows a clear pattern, which shows that it predominantly deters imports from China both in the long run and short run. The positive effect of real GDP per capita for South Africa is consistent with [Tarasov \(2012\)](#), which also established positive effect of per capital income on imports volume.

At this point, we summarize the findings from the second specific objective of this study as follows. We find that:

- the speed of adjustment ranges between 24% and 93%, but remained sluggish in South Africa, Kenya and Tanzania, suggesting that the adjustment of imports from China to its long-run equilibrium following shocks to CEPU may be asymmetric;
- in the long run, both rising and declining CEPU do not impact significantly on imports from China to Nigeria and Kenya;
- in the short term, while rising CEPU predominantly deters imports, the effect of declining CEPU is mainly negligible; and
- exchange rate fluctuation and real GDP per capita significantly hamper imports from China to most of these SSA economies, both in the long and short term, while LFP mainly enhances it.

From the diagnostic checks, the Breusch–Godfrey serial correlation tests indicate a problem of autocorrelation in South Africa and Kenya, while the models for South Africa, Kenya, Ghana and Angola revealed the presence of heteroscedasticity at the 5% level. These problems were corrected using the Newey–West HAC standard errors, but the asymmetric

patterns and the estimated coefficients remained consistent. The Pesaran *et al.* (2001) bounds test results and the t_{BDM} statistics showed the presence of equilibrium or cointegrating relationship among the variables in all cases. This is consistent with the choice of the underlying model, which we specified in its error correction form to capture both the equilibrium relationships and the short-run dynamics.

5. Concluding remarks and policy recommendations

This study applied the nonlinear ARDL framework to investigate the asymmetric effect of CEPU on trade between China and selected SSA countries over the quarterly period, 2000Q1 to 2022Q4. The study also evaluated the asymmetric effect of CEPU on imports from China to the selected SSA countries, which are Angola, Ghana, Kenya, Nigeria, South Africa and Tanzania. Among others, the study was motivated by the need to deepen the understanding of policymakers on how CEPU is impacting on the trade relationship existing between SSA countries and China, which has emerged not only as a major trade partner to most economies in the SSA region but has also become an influential factor in the global trading system.

The results generally revealed sluggish speed of adjustment, suggesting that the adjustments of trade with China and imports from China towards their long-run equilibrium paths may be asymmetric. We find that in the long term, both rising and falling CEPU enhances trade with China in Kenya, Ghana and Tanzania and significantly drives imports only in Ghana. We also find that in the short run, both increasing and decreasing CEPU predominantly enhances trade from China. However, rising CEPU significantly enhances imports only in Ghana in the short run, while the effect of declining CEPU on imports is mainly negligible. The results further indicate that exchange rate fluctuation and real GDP per capita significantly hamper imports from China and total trade with China, especially in the short run.

The foregoing results have some policy implications. Given the long-run results, policymakers and businesses in SSA countries should view periods of declining CEPU as opportunities to strengthen trade engagements with China and establish new trade relationships with other stable economies across the world. They should not passively observe periods of declining uncertainty but should proactively use them to solidify trade engagements with China. This entails enhancing trade agreements, strengthening supply chains, attracting foreign direct investment and developing local industries. By taking this strategic action, SSA economies can maximize benefits of stable trade relations with Chinese stable economies while preparing for potential future periods of heightened CEPU. The short-run adverse effect of CEPU in the SSA economies suggests that to mitigate the risk of CEPU, SSA economies should, again, diversify their trade partners. This can be achieved by expanding the export destinations of their products, deepening investments in their manufacturing, agriculture, petroleum and tourism. The diversification efforts should target expanding intra-African trade through African Continental Free Trade Area (AfCFTA), strengthening ties with emerging markets like India, Brazil and Turkey and leveraging agreements with the European Union and USA [e.g. the African Growth and Opportunity Act (AGOA)]. Industrialization efforts should focus on agro-processing, manufacturing and renewable energy production to reduce reliance on raw material exports. Evolving and implementing industrial policies that support manufacturing and high value-added industrial activities can strengthen export capacities of SSA economies and reduce their vulnerabilities to the adverse effects of CEPU.

In addition, consolidating intra-African trade through initiatives like the AfCFTA can to reduce the vulnerability of SSA economies to China economic uncertainties. These economies are therefore urged to take advantage of AfCFTA to improve and stabilize their

trade flows. Furthermore, businesses in SSA economies that are engaged in trade with China or reliant on imports should develop robust risk management strategies to navigate through periods of economic uncertainty. This includes conducting thorough risk assessments, diversifying supply chains and building strategic reserves to buffer against disruptions. Governments in the region can also support such businesses by providing access to resources and expertise to develop and implement effective risk management plans. In addition, to address the adverse impact of exchange rate fluctuations on trade between China and the SSA economies, this study recommends that countries in the region should adopt policies that can stabilize their foreign exchange markets. The use of foreign exchange reserves, exchange agreements and prudent fiscal policies can be helpful in this regard. Addressing the adverse effect of GDP per capita requires that policies aimed at improving economic growth in a more inclusive and sustainable manner should be embraced by the SSA economies. Besides, active partnership with multilateral institutions like the African Development Bank can also help SSA economies to promote fair trade practices and better hedge against the adverse effects of China economic uncertainty.

The encouraging effect of LFP on imports shows that investment in education, skills training and entrepreneurship can enhance the resilience of SSA economies to economic uncertainties. A skilled and adaptable workforce can drive innovation, diversification and competitiveness, thereby reducing reliance on external factors for economic growth and decreasing the adverse effect of GDP per capita. Governments ought to place a high priority on funding educational and career-training initiatives that provide people the tools they need to prosper in a world economy that is changing quickly. Policymakers in SSA countries should strive to enhance clarity and predictability in economic policies. Clear and consistent policies can help reduce uncertainty for businesses and investors, thereby promoting more stable trade relations.

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Table A1. Descriptive statistics of the variables

Angola	RGDPPC	GFCF	EXR	LFP	CEPU	IMPORT	TRADE
Mean	2720.216	25.07447	167.2210	94.84560	771.3865	1276.598	1759.121
SD	448.6545	9.204295	170.3380	0.911119	715.6909	868.9983	1206.696
Skewness	-0.372620	-1.427000	1.676796	-0.150979	1.283595	0.256462	0.293175
Kurtosis	1.800182	5.612680	4.529939	1.264085	3.301035	1.981874	2.164478
Jarque-Bera	7.647297	57.39040	52.08464	11.90089	25.61085	4.982074	3.993964
Probability	0.021848	0.000000	0.000000	0.002605	0.000003	0.082824	0.135744
Observations	92	92	92	92	92	92	92
<i>Ghana</i>							
Mean	1,499.717	20.90397	2.614564	91.03961	771.3865	116.0969	1,344.283
SD	354.4572	4.943314	2.107984	1.928878	715.6909	201.1771	2,080.326
Skewness	0.062627	0.104025	1.028829	0.503966	1.283595	2.397410	2.570716
Kurtosis	1.479772	1.760055	3.103587	1.918074	3.301035	7.720048	8.496203
Jarque-Bera	8.919328	6.059533	16.27131	8.381543	25.61085	173.5317	217.1299
Probability	0.011566	0.048327	0.000293	0.015135	0.000003	0.000000	0.000000
Observations	92	92	92	92	92	92	92
<i>Kenya</i>							
Mean	1,398.008	19.69106	87.69809	93.64339	771.3865	65.21805	695.8809
SD	182.6138	2.171294	14.10917	0.946020	715.6909	195.8112	572.4561
Skewness	0.384102	0.176373	0.476801	0.396626	1.283595	2.960963	0.277538
Kurtosis	1.904257	3.121040	2.032275	2.272515	3.301035	9.847157	1.501625
Jarque-Bera	6.864694	0.533141	7.075757	4.440851	25.61085	314.1523	9.787410
Probability	0.032311	0.766002	0.029075	0.108563	0.000003	0.000000	0.007494
Observations	92	92	92	92	92	92	92
<i>Nigeria</i>							
Mean	2,239.225	22.35168	198.9996	86.10463	771.3865	84.52051	1876.384
SD	365.0731	6.701762	98.64922	4.031345	715.6909	79.44422	1,506.132
Skewness	-0.770448	0.290265	1.062442	-0.751269	1.283595	1.209806	0.467610
Kurtosis	2.355543	1.765695	2.699514	1.855721	3.301035	4.141355	1.991994
Jarque-Bera	10.69380	7.132011	17.65412	13.67348	25.61085	27.43597	7.247729
Probability	0.004763	0.028269	0.000147	0.001074	0.000003	0.000001	0.026679
Observations	92	92	92	92	92	92	92
<i>South africa</i>							
Mean	5,806.950	16.94944	10.27799	77.18815	771.3865	1,294.975	1,903.975
SD	495.6505	2.104044	3.385848	2.295000	715.6909	1,304.242	1,581.400
Skewness	-1.019577	-0.213244	0.512334	-0.997740	1.283595	1.006467	0.895488
Kurtosis	2.581320	2.587255	1.766079	2.976817	3.301035	3.203158	3.358464
Jarque-Bera	16.61152	1.350292	9.861268	15.26616	25.61085	15.69051	12.78834
Probability	0.000247	0.509082	0.007222	0.000484	0.000003	0.000392	0.001671
Observations	92	92	92	92	92	92	92
<i>Tanzania</i>							
Mean	822.1686	31.85687	1,589.001	93.52841	771.3865	79.93758	550.2679
SD	164.4478	7.262474	520.9094	2.434223	715.6909	191.9219	464.4810
Skewness	-0.089222	-0.812130	0.194831	0.008302	1.283595	2.925947	0.353963
Kurtosis	1.683008	2.450682	1.563606	1.437468	3.301035	9.727118	1.671013
Jarque-Bera	6.770856	11.26988	8.491081	9.360170	25.61085	304.7454	8.691567
Probability	0.033863	0.003571	0.014328	0.009278	0.000003	0.000000	0.012961
Observations	92	92	92	92	92	92	92

Source(s): Authors' own work

Table A2. BDS test for CEPU

Dimension	BDS statistic	Std. error	z-statistic	Prob.
2	0.158974	0.009713	16.36780	0.0000
3	0.258157	0.015556	16.59482	0.0000
4	0.316649	0.018673	16.95740	0.0000
5	0.353181	0.019621	18.00010	0.0000
6	0.376005	0.019078	19.70892	0.0000

Source(s): Authors' own work

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