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Trade Openness and Inflation Rate in China: Empirical Evidence from Time Series Data

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Abstract: This study empirically examines the influence of trade openness on the rate of inflation by focusing on the Chinese economy. The study utilizes data covering the period 1987–2019 and employs the autoregressive distributed lag model (ARDL) for the extraction of results from the designed models. The results of the study indicate that trade openness has indeed impacted the rate of inflation not only negatively but also significantly. This means that trade openness could be used as a tool to fight against higher inflation. Similarly, government expenditure, economic growth, exchange rate and money supply positively affect inflation. Money supply and government expenditures positively affect the rate of inflation in the short run. The study has important policy implications for the Chinese economy.

Keywords: trade openness; inflation; ARDL; China

1. Introduction

Trade openness has improved the growth journey of numerous economies. Researchers have provided concrete evidence for the significant positive impact of trade on growth (Dollar 1992; Tahir 2020). Openness to trade openness brings multiple benefits for the host economies, including greater access to advanced technologies and extended markets. The East Asian economies achieved significant enhancement in growth because of openness to trade as pointed out by Tahir and Azid (2015). The policymakers of the Chinese economy realized the importance of outward oriented policies from a growth perspective in the late 1970s after the general failure of import substitution policies. Policymakers introduced various reforms in 1978 to liberalize the foreign trade regime (Hye et al. 2016) and expose the Chinese economy to the global economy. The policymakers of the Chinese economy have taken various steps to reduce tariffs during the 1990s (Guo 2013) to gain access to the World Trade Organization (WTO). China entered the World Trade Organization (WTO) in 2001, and the average tariff, which was 56% in 1982, was reduced to 15% by 2001 (Lardy 2005), which is a remarkable improvement in terms of trade liberalization. Due to the decrease in tariff and non-tariff barriers, in subsequent years, the total value of imports has increased, while the revenue generated from tariffs has declined (Guo 2013).

The reforms undertaken regarding trade liberalization have helped the Chinese economy to become a more open economy. China performed very well economically, and the GDP growth in 2019 reached 9.5%, which is indeed a remarkable achievement (Morrison 2019). The Chinese economy has successfully improved the lives of the millions of people

through better economic performance, which was made possible owing to the trade liberalization policies. The spectacular performance in terms of economic growth has enabled the Chinese economy to overcome the poverty problem, and 500 million people escaped the poverty line (Hye et al. 2016). Indeed, trade openness has contributed enormously to the Chinese economy in terms of growth.

This research paper deviates from the literature and explores the impact of trade openness on the inflation rate, which is a relatively interesting but less explored area in the context of the Chinese economy. Mehrotra et al. (2010) rightly pointed out that along with spectacular growth performance and economic importance, it is equally important to analyze the behavior of inflation as well. The Chinese economy has witnessed several phases of inflation after the comprehensive structural reforms undertaken by policymakers (Ha et al. 2003). The Chinese economy has experienced extensive trade liberalization during the last few decades. However, the impact of the trade liberalization process on the inflation rate is yet to be researched extensively. Investigation of the determinants of inflation is indeed vital in the context of the Chinese economy, as pointed out by researchers (Dreger and Zhang 2013; Mehrotra et al. 2010; Ha et al. 2003). Therefore, in this paper we investigate the factors of inflation with the prime focus on trade openness. This area is interesting but relatively unexplored. Consequently, it is expected that policymakers of the Chinese economy would benefit significantly from the results of this study.

There are sound reasons to believe that trade may have an impact on the rate of inflation. Theoretically, Romer (1993) proposed that economies with open trade policies are experiencing relatively low inflation as compared to closed economies. Consistent with this view, Dachito and Alemu (2017) discussed the proposition and stated that relatively open economies have less inflation, which implies that protectionist policies lead to inflationary pressure in the economy. Further, they argued that the positive influence of trade on inflation is also mentioned in the literature by the advocates of cost push. Empirical research studies are largely inconclusive owing to mixed results. For instance, the study of Yiheyis (2013) demonstrated that openness to trade has positively impacted the inflation rate in African economies. Similarly, Zakaria (2010) and Chhabra and Alam (2020) reported that trade openness has influenced the inflation rate positively in Pakistan and India. On the contrary, Samimi et al. (2012) demonstrated that the traditional trade volume measure of trade openness is positively linked with the inflation rate, while overall globalization is negatively associated with the inflation rate. Moreover, the study of Lin (2010) demonstrated an adverse impact of openness to trade on the inflation rate. These contradictory findings have motivated us to test the potential impact that openness to trade has on the inflation rate by focusing on the giant economy of China.

The main finding of the present study suggests openness to trade is beneficial for reducing inflation in the context of the Chinese economy. The obtained results are in line with the Romer (1993) hypothesis. This suggests that the long-run policies aimed at more openness translate into low inflation and are more effective in stabilizing inflation. On the other hand, exchange rate, money supply, economic growth and government expenditures are found to be responsible for increasing the inflation rate.

The next section discusses the past literature on trade openness and inflation. Section 3 discusses data and methodology. Section 4 reports the descriptive statistics, unit root and cointegration results. Section 5 is devoted to discussion of regression results and diagnostic testing. The final section concludes the major findings, highlights the limitations and further suggests research directions for future researchers.

2. Literature Review

The relationship between trade and inflation has received significant attention from policymakers and researchers over the years. However, the findings reported by researchers are mixed or inconclusive. Lin et al. (2017) pointed out that the relationship between trade and inflation is researched by many studies. However, despite the extensive literature, the debate is still not settled owing to diverse and mixed findings. In a comprehensive

paper, Romer (1993) demonstrated an adverse influence of openness on inflation and further documented that trade openness is negatively associated with the inflation rate in economies with less stability and less central bank independence. This implies that the inflation rate is relatively low in open economies as compared to closed economies. However, Dachito and Alemu (2017) pointed out that trade openness may also cause inflation in the domestic economy due to the importation of foreign inflation, associated with foreign manufactured goods and inputs.

Various researchers have tried to test the potential consequences of trade openness on the inflation rate empirically due to theoretical ambiguities. The novel paper of Yiheyis (2013) focused on Africa to highlight the impact of trade openness on inflation and demonstrated a positive relationship. Similarly, Zakaria (2010) demonstrated a positive relationship between trade openness and the inflation rate. The study of Evans (2007) also displayed a positive impact of trade on the inflation rate. The Indian economy also experienced higher inflation owing to trade openness as shown by the findings of Chhabra and Alam (2020). Samimi et al. (2012) stated that the trade volume measure of openness is positively linked with inflation. Further, they demonstrated that the negative influence of trade on inflation is only valid for overall economic globalization (KOF index). Al Nasser et al. (2009) carried out a comprehensive study by focusing on 152 countries for the period 1950–1992 and concluded that trade openness reduces inflation. Moreover, in a recent study, it stated that increased trade openness leads to reduction in inflation; however, this relationship is dependent on the state of the economy.

Ha et al. (2003) pointed out that the Chinese economy has witnessed various phases of inflation since the structural reforms introduced by the policymakers. However, on the empirical side, few researchers have tried to explore the determinants of the inflation rate for the Chinese economy. For instance, Huang et al. (2010) have reported that output gap, excess liquidity and housing prices are positively related to the inflation rate. On the other hand, Mehrotra et al. (2010) have focused on 29 provinces of China using data from 1978–2004 through the application of the NKPC model and reported that the forward-looking component is statistically significant in 22 provinces. Dreger and Zhang (2013) documented that inflation in China was mainly driven by international factors before the financial crisis, while after the crisis period, domestic factors were mainly responsible for accelerating the inflation rate. Similarly, Nagayasu (2010) empirically demonstrated that the inflation rate in China could be explained by money supply, productivity and exchange rate.

It can be concluded that the influence of openness to trade on inflation is rarely researched as far as the Chinese economy is concerned. Despite this, some researchers have tried to model the determinants of inflation in China. This is an under-researched area, and therefore we try to fill this gap in this paper by investigating the impact of trade openness on the inflation rate by focusing on China. The results of the study will no doubt be of significant interest for the policymakers of the Chinese economy.

3. Modeling and Methodology

3.1. Modeling Design

This section is devoted to specifying the model for analysis. The inflation rate could be influenced by several factors other than trade openness. For instance, Adu and Marbuah (2011) stated that the money supply and exchange rate are mainly responsible for inflation. Similarly, government expenditures can also contribute to inflation though the channel of aggregate demand. Bashir et al. (2011) empirically demonstrated that government expenditures can cause inflation in the economy. Similarly, the study of Kostov (2017) showed that economic growth could also influence the rate of inflation. Finally, the study of Huang et al. (2010) indicated the importance of an effective exchange rate for inflation. The following functional form is specified for empirical purposes.

$$LNCPI_t = \beta_O + \beta_1 LNOPEN_t + \beta_2 LNMS_t + \beta_3 LNEXR_t + \beta_3 LNGEX_t + \beta_4 ECG_t + U_t \quad (1)$$

In expression (1), the growth rate of the consumer price index is used as a measure of the inflation rate. Trade openness is measured by the ratio of total trade to GDP, while broad money (% of GDP) is used as proxy for money supply in the economy. Growth is calculated by taking log differences of GDP per capita, while government expenditures in the economy are measured by taking the total general government consumption expenditures (% of GDP). Data on all the mentioned variables were sourced from World Development Indicators.

3.2. Estimation Issues and Solutions

One of the main assumptions of using the ordinary least squares (OLS) is that variables included in the model should not exhibit the unit root problem. However, the unit root problem is very common in time series data. Against this backdrop, an alternative solution is to employ the cointegration framework. There are mainly three valid cointegration procedures: the Engle and Granger (1987) method, the Johansen (1988) test and the ARDL test developed by Pesaran et al. (2001).

The ARDL model is quite flexible, and it works relatively well with few observations and variables with mixed integration order (Tahir 2020). it documented that the ARDL model does not require pre-testing of the unit root as it can cure variables with a different order of integration. Due to the mentioned benefits, ARDL modeling has been used extensively in applied research. We also preferred the use of the ARDL approach over the Johansen (1988) test in this study. The ARDL framework is specified as follows.

$$
\begin{aligned}
\Delta LNCPI_t = \beta_0 &+ \sum_{i=1}^{n1} \beta_{1i}\Delta LNCPI_{t-i} + \sum_{i=0}^{n2} \beta_{2i}\Delta LNOPEN_{t-i} + \sum_{i=0}^{n3} \beta_{3i}\Delta LNMS_{t-i} + \sum_{i=0}^{n4} \beta_{4i}\Delta LNEXR_{t-i} + \\
&\sum_{i=0}^{n5} \beta_{5i}\Delta LNGEX_{t-i} + \sum_{i=0}^{n6} \beta_{6i}\Delta ECG_{t-i} + \omega_1 LNCPI_{t-1} + \omega_2 LNOPEN_{t-1} + \omega_3 LNMS_{t-1} + \\
&\omega_4 LNEXR_{t-1} + \omega_5 LNGEX_{t-1} + \omega_6 ECG_{t-1} + \varepsilon_t
\end{aligned}
\tag{2}
$$

In expression (2), the terms with difference operators denote the short-run relationships. Similarly, the parameters with the lag terms represent the long-run relationships. The presence or absence of the cointegrating relationship can be examined with the help of the hypothesis given below. The null hypothesis accepts the absence of cointegration. The alternative hypothesis accepts the existence of cointegrating relationships.

$H_0 : \omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = \omega_6 = 0$ (N.H)

$H_1 : \omega_1 \neq \omega_2 \neq \omega_3 \neq \omega_4 \neq \omega_5 \neq \omega_6 \neq 0$ (A.H)

4. Findings and Discussion

4.1. Descriptives

The descriptive statistics are reported in Table 1. The average inflation rate for the sampled period is around 5 percent, with a maximum value of 24.25 and minimum of −1.4 percent, respectively. The Chinese economy experienced its highest inflation rate in 1994, while the lowest was seen in 1999. The value of inflation is the standard deviation of the inflation rate, which is 6.340. Trade openness is 41.003 on average. The maximum value of trade openness is 64.478 for the year 2006, while the minimum value of trade openness, 24.273, is observed for the year 1990. Similarly, the mean of money supply is 140.648. The maximum (207.673) and minimum (63.253) values of money supply are recorded for the year 2016 and 1988, respectively. Government expenditures in the economy are 14.943 on average. The highest and lowest government expenditures in the Chinese economy were observed in 2000 and 1988, respectively. The exchange rate, which is used as one of the determinants of the inflation rate, is on average 100.622 for the Chinese economy, while the maximum value is 136.309, and the minimum value is 70.522. Finally, the mean of GDP per capita is 3177.221 in constant USD. The maximum value is recorded for 2019, while the minimum value is in 1987.

Table 1. Summary of statistics.

Description	CPI (Growth)	MS	OPEN	EXR	GEX	ECG
Mean	5.044	140.648	41.003	100.622	14.943	3177.221
Maximum	24.256	207.673	64.478	136.309	16.838	8242.055
Minimum	−1.401	63.253	24.273	70.522	12.497	634.062
Std. Dev.	6.340	44.473	11.390	15.920	1.212	2383.879
Observations	33	33	33	33	33	33

4.2. Unit Root Analysis

The unit root findings of the augmented Dickey–Fuller (ADF) test are shown in Table 2. The results showed that, except government expenditures, all variables are stationary only at first difference. The integration order is different for variables. Hence, the ARDL modeling is appropriate.

Table 2. ADF results.

Variables	Level	Difference	Result
$LNCPI_t$	−2.872	−5.089 ***,*	I(1)
$LNOPEN_t$	−0.805	−4.697 ***	I(1)
$LNMS_t$	−1.247	−4.920 ***	I(1)
$LNGEX_t$	−4.148 **	−3.577 **	I(0)
$LNEXR_t$	−2.671	−5.447 ***	I(1)
ECG_t	−2.361	−5.247 ***	I(1)

Note: ***, ** and * denote 1%, 5% and 10% significance levels.

4.3. Bound Testing

Results of the bound test are reported in Table 3. According to results, the presence of cointegration is confirmed as the null hypothesis of no cointegration is rejected for estimated model 2. The F-value is 5.911, which is more than the critical value.

Table 3. ARDL results.

Specification	F-Test	Result
F (LNCPI/LNOPEN, LNMS, LNEXR, LNGEX, ECG)	5.911	Co-integrated
Level (%)	**Lower I (0)**	**Upper I (1)**
1	(3.41)	(4.68)
5	(3.62)	(3.79)
10	(2.26)	(3.35)

We also designed error correction models (ECMs). The ECM generally shows adjustment speeds and short-run relationships. The ECMs are specified as follows. In model (3), the terms (ECT_{t-1}) represent the error correction.

$$\Delta LNCPI_t = \beta_0 + \sum_{i=1}^{n1} \beta_{1i}\Delta LNCPI_{t-i} + \sum_{i=0}^{n2} \beta_{2i}\Delta LNOPEN_{t-i} + \sum_{i=0}^{n3} \beta_{3i}\Delta LNMS_{t-i} + \sum_{i=0}^{n4} \beta_{4i}\Delta LNEXR_{t-i} + \sum_{i=0}^{n5} \beta_{5i}\Delta LNGEX_{t-i} + \sum_{i=0}^{n6} \beta_{6i}\Delta ECG_{t-i} + \omega_1 ECT_{t-1} + \varepsilon_t \tag{3}$$

5. Cointegration Results

The long-term results are provided in the upper section of Table 4. The results demonstrate a negative and statistically significant influence of trade on the inflation rate for the

Chinese economy. The hypothesis of Romer (1993) is accepted in the context of the Chinese economy. Sachsida et al. (2003) also provided evidence for the validity of the negative openness–inflation nexuses. On the other hand, Yiheyis (2013) did not find support for the adverse impact of trade on inflation. Increased inflation in the economy creates uncertainties and hence an adversely impacted optimal role of stakeholders in the growth process (Tahir and Azid 2015). China is therefore suggested to enhance the speed of its trade liberalization journey to experience not only higher growth but also combat inflation. Increased liberalization will benefit the Chinese economy both in terms of growth and stability.

Money supply appeared to be one of the main driving forces behind increased inflation in the Chinese economy. The coefficient of the money supply in the estimated model is both positive and different from zero statistically. Increased money supply, which is also called the inflation tax, leads to significant inflationary pressure in the economy, and hence policies targeted towards growth and development become less effective. Previous research also showed the harmful impacts of money on inflation in different countries. Adu and Marbuah (2011) also reported the positive impact that money supply has on the inflation rate by focusing on Ghana. Tolasa et al. (2022) demonstrated that inflation in Ethiopia is driven by money supply. He and Fan (2015) stated that money supply is the most important determinant of the inflation rate in the context of the Chinese economy. Therefore, the Chinese policymakers are suggested to exercise a tight monetary policy to control inflationary pressure in the economy, which hurts the general public.

Government expenditures in the economy have also contributed to inflation in China. Government expenditures in the economy positively influence aggregate demand, and hence prices consequently increase. Therefore, government expenditures need to be curtailed to avoid inflationary pressure as inflation hurts all sectors adversely. The previous literature also showed that government expenditures lead to inflationary pressure. Bashir et al. (2011) also showed that increased government expenditures in the economy positively contribute to inflation. Therefore, a contractionary fiscal policy could be considered by policymakers to stem the high inflation.

The results also showed that economic growth has impacted positively the level of inflation in the Chinese economy. The coefficient of economic growth is significant and positive. This implies that higher economic growth may also lead to higher inflation in the economy. Kostov (2017) also showed similar results. The comprehensive research of Tolasa et al. (2022) also showed that economic growth drives inflation in Ethiopia. Therefore, the desire to experience higher growth will be followed by higher inflation. This implies that there is generally a tradeoff between higher growth and inflation. Therefore, authorities of the Chinese economy are suggested to monitor the growth process carefully. On the other hand, the study of Mallik and Chowdhury (2001) provided two-way linkages between growth and the inflation rate.

Finally, the results revealed a positive and statistically significant relationship between the exchange rate and inflation rate. Theoretically, the higher the real effective exchange rate, the lower the inflation rate as aggregate demand is lower, and vice versa. However, the behavior of other variables determining inflation could change the relationship between the real effective exchange rate and inflation from negative to positive. Ahmed et al. (2014) and Ture and Khazaei (2022) also displayed similar results about the impact of the exchange rate on inflation. A significant depreciation of local currency primarily raises inflation, which is undesirable. Rising inflation no doubt hurts all sectors as documented by Tahir and Azid (2015). Exchange rate dynamics are harmful as they impact both inflation and growth in countries. The Chinese government should also take steps to minimize significant variations in the exchange rate. Some studies also showed that the inflation rate could be adversely influenced by the exchange rate. The positive effect of an effective exchange rate on inflation is inconsistent with the findings of Huang et al. (2010) who reported a negative relationship between the exchange rate and inflation.

In the short run, only money supply and expenses of government have maintained their positive relationships with the inflation rate. All other variables turned from signifi-

cant to insignificant. This implies that both economic growth and an effective exchange rate determine inflation only in the long run. Similarly, trade openness carries an insignificant positive coefficient in the short run. This means that trade openness could be used as a tool only for inflation reduction in the long run. The coefficient of ECT shown in the bottom of Table 4 is −0.20. This shows that adjustment speed is approximately 20 percent. This implies that the disequilibrium is corrected at a reasonable speed.

Table 4. Results.

Variables	Coefficients	Standard Error	*t*-Test
Long-run			
LNOPEN$_t$	−0.426 **	0.159	−2.671
LNEXR$_t$	0.997 *	0.549	1.814
LNGEX$_t$	1.160 *	0.611	1.896
LNMS$_t$	0.758 ***	0.242	3.133
ECG$_t$	13.876 ***	4.176	3.322
Short-run			
ΔLNOPEN$_t$	0.006	0.053	0.123
ΔLNEXR$_t$	0.017	0.058	0.302
ΔLNGEX$_t$	0.238 **	0.097	2.455
ΔLNMS$_t$	0.196 *	0.101	1.928
ΔECG$_t$	0.246	0.332	0.742
ECT (−1)	−0.205 ***	0.047	−4.289
DW test	2.159		
Adj-R-Squared	0.998		

Note: ***, ** and * denote 1%, 5% and 10% significance levels.

5.1. Diagnostic Tests

In order to corroborate the results, the several tests were conducted in this study for the validation of the estimated models. The validity of models is confirmed from the results displayed in Table 5. In particular, the null hypothesis of the LM test, which assumes no serial correlation, is not rejected. The White test and ARCH also confirm the absence of heteroscedasticity. Finally, the normality and correct functional form hypothesis are also accepted. Therefore, our results from the estimated models are valid and correct and hence could be considered by policymakers in policy formulation and implementation.

Table 5. Validity testing.

Names	Hypothesis	(F. Stat + p Value)	Result
L.M Test	H_0 : No Correlation	1.343 (0.304)	H_0: Accepted
ARCH	H_0 : Homoskedasticity	0.092 (0.763)	H_0: Accepted
White Test	H_0 : Homoskedasticity	0.807 (0.661)	H_0: Accepted
Normality	H_0 : Residuals are Normal	0.412 (0.813)	H_0: Accepted
Ramsey Test	H_0 : Correct Functional Form	0.288 (0.601)	H_0: Accepted

5.2. Stability Tests

Two stability tests were conducted in this study. Figures 1 and 2 illustrate the results. Both the figures indicate the presence of stability as the blue lines are lying between the critical limits. Therefore, the estimated models are reliable.
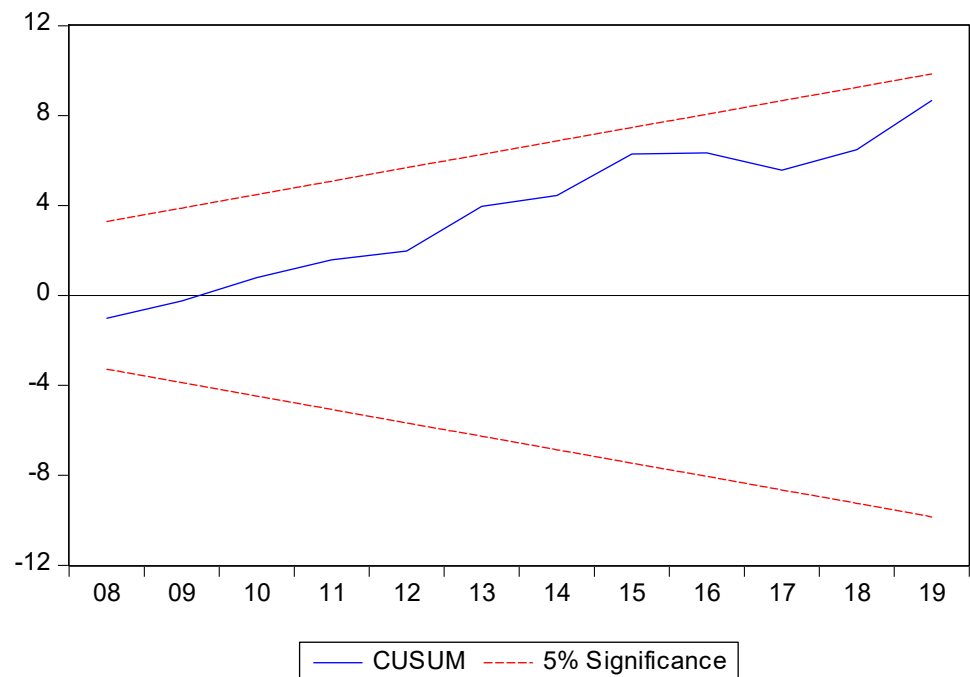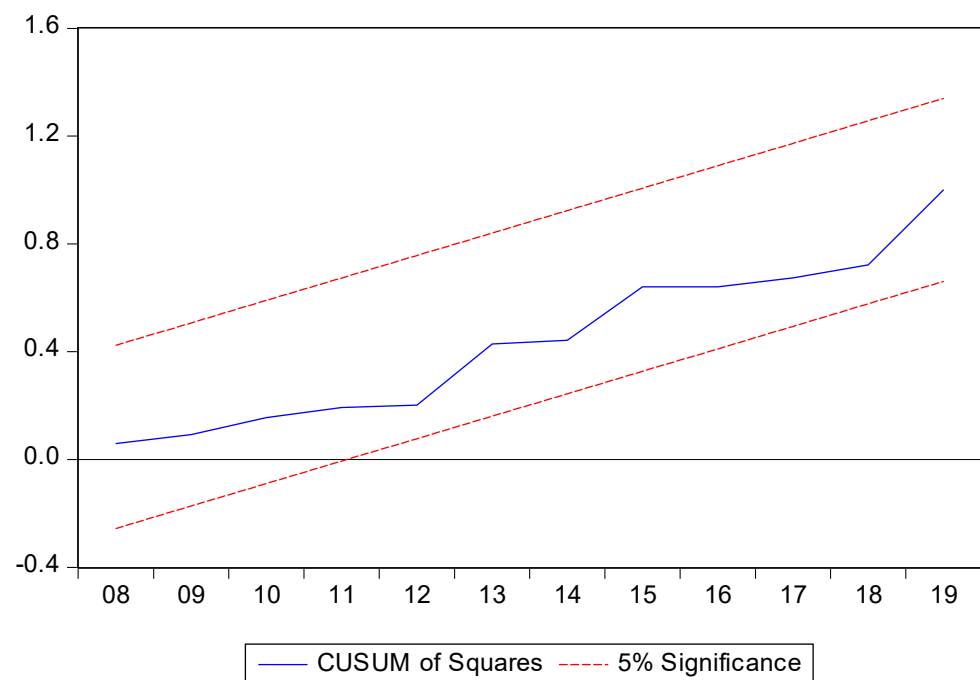
Figure 1. CUSUM Test.

Figure 2. CUSUM (square).

6. Conclusions

The aim of the present study is to investigate whether trade openness in China reduces inflation. Data for the period 1987–2019 were sourced from credible sources. For estimation purposes, ARDL modeling was employed.

The results provided evidence for a negative impact of openness to trade on the inflation rate in the Chinese economy, which is the reflection of the fact that more open economies are experiencing relatively low inflation. The results regarding trade openness and the inflation rate could serve as a guideline for the developing countries to follow

the policy of trade liberalization to not only enhance economic growth but also ensure lower inflation, which is required from the perspective of improving standards of living. Besides trade openness, government expenses also influenced inflation positively. Growth also appeared as one of the determinants of the inflation rate in the Chinese economy. However, higher economic growth also has spillover effects, including rising income of the population, which ultimately helps to absorb the inflationary pressure. Increased money supply creates inflationary pressure, and hence the monetary authorities are required to constantly monitor the supply of money and ensure that it does not exceed the supply of goods and services to control inflation. Finally, evidence is obtained based on results about the positive impact of the real effective exchange rate and the inflation rate, which is contrary to our prior expectation. However, the behavior of other variables determining inflation could change the relationship between the real effective exchange rate and inflation from negative to positive.

6.1. Limitations

(1) The present study is only limited to five determinants of the inflation rate. The inflation rate can also be impacted by several other factors.
(2) The study is limited to only cointegrating tools, while causality techniques are not employed.
(3) The time period used is relatively small as prior data were not consistently available.

6.2. Future Research Directions

The present study can be extended in the following ways.

(1) It is suggested to explore the spillover effects of trade openness from China on the inflation rate of trading partners. This area is the least explored in the literature.
(2) The specified models could be verified by testing them on some other emerging economies.
(3) A comparative study by considering post-reform and pre-reform periods will also significantly contribute to the literature.

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