

Threshold in the Relationship between Inflation and Economic Growth: Empirical Evidence in Vietnam

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Abstract

This paper aims to determine a threshold level in the relationship between inflation and economic growth in Vietnam. Our paper is considered as one of the first empirical studies on inflation threshold in Vietnam - a country in transition from a communist centrally-planned to a market economy. The research applied three regression methods including Ordinary Least Squares (OLS), Two-Stages Least Squares (2-SLS) and Generalized Method of Moments (GMM) with annual data for the period of 1986 - 2013. The results consistently concluded that the inflation threshold is about 7 percent, which means inflation will be detrimental to economic growth if inflation rate exceeds 7 percent. Therefore, the policy-makers in Vietnam need to define a target inflation rate lower than this level to stabilize economic growth. The results also indicated that the Government should increase investment as well as enhance the effectiveness of investment to foster economic growth. Finally, Vietnam should stabilize trade balance to favor economic growth in long term.

Keywords: economic growth, inflation, inflation threshold, threshold model

1. Introduction

High economic growth and low inflation are the most important objectives of macroeconomic policies in developing economies. Therefore, the relationship between inflation and economic growth is an important issue for most countries, and has attracted much attention among the economists and researchers. According to the modern macroeconomic theories, a country needs to associate high growth with moderate inflation rate and low unemployment rate to achieve sustainable economic growth.

Many studies indicated that inflation has a negative effect on economic growth in medium and long term (De Gregorio, 1992; Barro, 1991, 1995, 2013; Carlos, 2003; Bruno & Easterly, 2008; Bittencourt, 2012). However, some empirical studies also confirmed the relationship between inflation and economic growth in long term is not linear but nonlinear (Fischer, 1993; Sarel, 1996; Ghosh & Phillips, 1998; Khan & Senhadji, 2001). In particular, inflation at low rate will stimulate economic growth, but high inflation will inhibit growth process. In other words, there is, at low inflation rate, a positive relationship between inflation and growth (Inflation fosters growth) or no impact of inflation on growth; however, at higher inflation rate, the inflation-growth nexus becomes negative (Inflation is detrimental to growth). Therefore, which inflation level is appropriate for an economy? The answer is different among countries because this level depends on the countries' characteristics. In each country, there exists a threshold point at which the relation between inflation and economic growth will turn from positive to negative. Therefore, each country needs to specify an optimal inflation rate for economic growth as a basis for appropriate policy adjustments.

This paper focused on analyzing the relationship between inflation and economic growth in Vietnam - a developing country in the Southeast Asia over the period from 1986 to 2013. The identified inflation threshold from analysis result will be considered as a basis for the policy-makers to establish target inflation rate for Vietnam's policy adjustments in the future. In addition, the findings from this paper will contribute to the theoretical framework of threshold in the relation between inflation and economic growth and be considered as an evidence for policy planning in developing countries.

The structure of this paper is organized as follows: Section 1 presents introduction. Section 2 is an overview of inflation and economic growth in Vietnam in the research period. Section 3 presents literature review. Econometric methodology and data description are showed in Section 4. Section 5 reports the research results and discussion. Finally, Section 6 includes conclusions and policy recommendations.

2. An Overview of Economy, Inflation and Economic Growth in Vietnam

According to the statistical data by World Bank in 2013, Vietnam was ranked as the 6th largest economy in Southeast Asia and the 42th in the world. Vietnam's Gross Domestic Product (GDP) is approximately \$171.4 billion and economic growth rate is about 5.6 percent. The population is approximately 91 million and labor force accounts for 58 percent (around 53 million). With respect to Vietnam's economic structure, industrial sector accounts for 41.8 percent, compared to 39.1 percent and 20.1 percent that are contributed by service and agricultural sectors respectively. According to a report of Vietnam General Statistics Office (GSO) in 2012, capital investment in Vietnam's economy is constituted by the State-owned sector (37.8 percent), the private sector (38.9 percent) and the foreign-invested sector (23.3 percent). Although Vietnam's economy is much dependent on oil exports, primary product and foreign direct investment (FDI), Vietnam is still considered as a country with great potentials and resources for economic growth.

Similar to many developing countries, inflation is a main reason for the instability of economic growth and social development process in Vietnam during three recent decades. In the 1980s, Vietnam's economy encountered both galloping inflation and hyperinflation, but the Government's inflation control policies had low efficiency, which led to a serious crisis. In addition, a prolonged economic crisis resulted in a scarcity of consumer goods, inputs deficit and production stagnation. Moreover, the Government increased money supply to compensate for budget deficit, which resulted in higher inflation rate. In 1986, the Vietnam's Government implemented a revolution in economic management, namely Doi Moi, with the aim at economic reform and changing Vietnam's economy from a communist centrally-planned to market economy. In addition to the change in economic model, the Government also applied many macroeconomic policies to reduce inflation rate and stabilize the economy. In 1987, Vietnam allowed the development of private economic sector, promoted the attraction of FDI, developed an open economy and enhanced global economic integration. In the 1990s, with the great efforts of the Government and the high efficiency of macroeconomic policies, the hyperinflation inflation was controlled and declined from 411.1 percent in 1988 to 16.9 percent in 1994. In addition, Vietnam's economy recovered with a rise in economic growth from 5.1 percent in 1990 up to 8.8 percent in 1994. Since 1995, Vietnam put an end to economic crisis, brought the economy to the rapid growth stage and successfully implemented the industrialization-modernization process. Vietnam's Government learnt many lessons from the rise of inflation rate in the past period, and thence monetary policy-makers started to consider inflation adjustment as a primary goal of policies planning and implementing process.

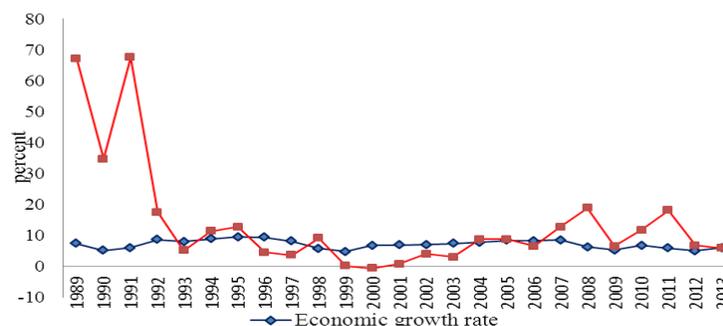


Figure 1. Inflation and economic growth in Vietnam, 1989-2013

Source: World Bank (World Development Indicators)

In the next period of 1995-2007, inflation rates in Vietnam were at moderate level and had a stable trend in long term. With the success in maintaining inflation rate at moderate level, Vietnam achieved high and sustainable economic growth. The average growth rate in Vietnam was 7.6 percent per year while the average inflation rate is 5.7 percent a year in the period of 1995 - 2007. In this period, Vietnam was ranked as the 2nd highest growth rate in Asia and categorized into the group of countries with top economic growth rate in the world. The maintenance of inflation rate contributed to the reduction in poverty from 48 percent in 1993 to 12 percent in 2007. Vietnam became a role model as a country with success in economic transition in the world.

However, since the end of 2007, there was a dramatic increase in inflation rate up to galloping inflation as well as a reduction in economic growth and an instability in the economy. In particular, the average inflation rate in Vietnam increased remarkably up to 11.1 percent per year, and thence the average growth decreased sharply to 4.9 percent per year in the 2007-2013 period. It was noteworthy that a rise in annual inflation rate up to 22.7 percent in 2008 and 21.2 percent in 2011 indicated an obvious decrease in economic growth from 8.4 percent to 6.3 percent in 2008 and from 6.8 percent to 5.3 percent in 2011.

A report on Vietnam's economy in the period of 1986-2013 showed that if annual inflation rate fluctuated from 5 percent to 8 percent, it will lead to higher growth rate. In contrast, an annual inflation rate higher than this threshold will result in economic instability and dramatic decline in economic growth. In other words, it seemed that high inflation rate will be detrimental to economic growth. For the case of Vietnam, at which level is inflation considered to be too high? 10 percent, 8 percent or 3 percent? There has been no empirical study that has obvious conclusion about whether the relationship between inflation and economic growth in Vietnam is linear or non-linear. If a non-linear relationship was found, there must be a threshold level at which the relationship will be changed from positive to negative.

Thenceforth, the non-linear relationship between inflation and economic growth as well as inflation threshold is considered as a research gap in Vietnam. To maintain long-term economic growth, the policy-makers in Vietnam should keep inflation rate at an appropriate level. The policy-makers need to define a target inflation rate to control inflation close to that level. An identification of inflation threshold can answer many questions such as: Is there any threshold effect for the case of Vietnam? How high should inflation be in Vietnam? Or how should the target inflation in Vietnam be in future?

Therefore, this research is conducted for the following objectives: (1) Construct econometric model to determine a threshold for the relationship between inflation and economic growth in Vietnam. (2) Recommend policies to stabilize inflation rate and stimulate more sustainable and faster economic growth in Vietnam for the upcoming period.

3. Literature Review and Empirical Research

The relationship between inflation and economic growth is very important issue in macroeconomics. However, this topic has received various and inconsistent results from the economists in all over the world. The first research was conducted by Fischer (1993) who identified the existence of inflation threshold in the relationship between inflation and economic growth; that is, the relationship may be positive at low rates but become negative at higher rate. Sarel (1996) found that inflation threshold to be 8 percent in a research using a sample of 87 countries for the period 1970-1990. In particular, the relationship between inflation and growth, below this rate, is insignificantly positive (or maybe a positive effect) but turns negative at inflation rates higher than this threshold. The existence of inflation threshold was studied by Ghosh and Phillips (1998) who examined a database for the case of 145 countries during the period from 1960 to 1996, and found the existence of a threshold at 2.5 percent. Christoffersen and Doyle (2000) studied a sample of 22 European countries for the period 1990-1997 and concluded an optimal inflation rate of 13 percent (inflation threshold). In another research on the relationship between inflation and economic growth for the case of 31 countries, Bruno and Easterly (1998) indicated that growth decreases dramatically when inflation rate is higher than a threshold of 40 percent; however, economic growth increases rapidly and strongly as a result of decline in inflation rate. In a research for the case of 142 countries from 1959 to 1972, Judson and Orphanides (1999) found the inflation threshold to be at 10 percent; that is, if the inflation rate is higher than this threshold, it will jeopardize the growth.

In order to define the existence of inflation threshold, Khan and Senhadji (2001) employed a large dataset of 140 countries using non-linear least squares to calculate this inflation rate. They found the inflation threshold above which inflation is detrimental to economic growth to be at 11-12 percent for developing countries and 1-3 percent for industrial countries. A similar result for the case of 170 countries in the period of 1960-1992 (average 5-year unit) is by Gylfason and Herbertsson (2001) who also found that the relationship between inflation and economic growth is non-linear, and there exists an inflation threshold at around 10 percent; that is, annual inflation rates higher than 10-20 percent will result in a decrease in economic growth.

With an adoption of panel data of 138 countries from 1950 to 2000, Drukker, Porqueras and Hernandez (2005) assumed an inflation threshold to be at 19.16 percent for all the sample countries, and at 2.57 percent and 12.61 percent for the industrialized countries. A research by Vaona and Schiavo (2007) for the period 1960-1999 with sample size of 167 countries found that there is a non-linear nexus between inflation and economic growth; and an inflation threshold below which inflation rate has no impact on economic growth.

Kremer, Bick and Nautz (2013) also used a quite large sample of 124 countries over the period from 1950 to 2004 in combination with an application of dynamic panel threshold model, and then indicated that inflation threshold is at about 2 percent for industrialized countries. In particular, inflation hampers growth when it exceeds 17 percent for non-industrialized countries; however, if inflation rate is lower than this threshold, the impact of inflation on economic growth is insignificant. In a research by Omay and Kan (2010) with an application of panel smooth transition regression (PSTR) using a panel data for 6 industrialized countries (including Canada, France, Italy, Japan, UK and US) in the period 1972-2005, inflation threshold was determined to be at around 2.44 percent to 3.18 percent. Therefore, these authors suggested target inflation to be around 2 percent for industrialized countries in the research sample.

Villavicencio and Mignon (2011) also conducted a research on a sample of 44 countries over the period of 1961-2007, including both emerging and industrialized countries. With an application of Smooth transition and dynamic GMM model, they showed that inflation has non-linear impact on economic growth, and found an inflation threshold to be at 2.7 percent for the industrialized countries and 17.5 percent for the emerging countries. Using a dynamic panel threshold model with the data of 19 MENA countries in Africa from 1961 to 1990, Ghazouani (2012) defined an inflation threshold to be about 10 percent.

More recently, Seleteng, Bittencourt and Eyden (2013) applied the panel smooth transition regression method to investigate the inflation-growth nexus in the SADC region of Southern Africa from 1980 to 2008. Their findings discovered a threshold level of 18.9 percent above which inflation is harmful to growth in the countries in this region. In another research on inflation threshold, Vinayagathan (2013) applied a dynamic panel threshold growth regression to study the existence of a threshold level for the relationship between inflation and economic growth for the case of 32 Asian countries (including Vietnam) over the 1980-2009 period. This paper showed that growth is jeopardized when inflation rate surpasses 5.43 percent while inflation lower than this level will have no impact on growth.

In addition to the studies using panel data for large sample, some author applied data set at country level in their research. Salami and Kelikume (2010) employed a nonlinear inflation-growth model for the case of Nigeria's economy. Their study concluded an inflation threshold of 8 percent over the sample period of 1970-2008. However, the inflation threshold declines to only 7 percent when they extended annual time series up to the period of 1980-2008. Hasanov (2010) also studied the threshold effect of inflation on economic growth in Azerbaijani in the period of 2000-2009, and then identified the existence of inflation threshold of 13 percent in the inflation-growth nexus. The paper also confirmed that the growth is expected to decline by about 3 percent when inflation rises is higher than this threshold level. In a research on the nexus between economic growth and inflation in Pakistan using annual data in the period of 1960-2006, Hussain and Malik (2011) defined the threshold inflation level to be 9 percent. On the basis of this finding, they suggested that policy-makers should control the target inflation below this threshold to maintain the positive relationship between inflation and economic growth.

4. Methodology and Data Description

4.1 The Threshold Econometric Model

On the basis of theoretical framework by Fischer (1993), Sarel (1996), Ghosh and Phillips (1998), the threshold model was developed by Khan and Senhadji (2001). This model was also applied by such authors as Salami and Kelikume (2010), Hussain and Malik (2011). Thenceforth, our paper employed this model to define the inflation threshold level above which inflation could be detrimental to economic growth in Vietnam. The inflation threshold in Vietnam is based on the following formula:

$$\Delta GDP_t = \beta_0 + \beta_1 DU_t (INF_t - k) + \beta_3 X_t + \varepsilon_t \quad (1)$$

$$DU_t = \begin{cases} 1 & \text{if } INF_t > k \\ 0 & \text{if } INF_t \leq k \end{cases} \quad (2)$$

In equation (1), ΔGDP denotes growth of real GDP which represents economic growth; INF denotes inflation rate which represents average percentage change in consumer price index (CPI). X is a matrix of explanatory variables including: Ratio of gross domestic investment to GDP (INV); Population growth rate (POP); Trade openness (OPENNESS) calculated by the sum of exports and imports over GDP; Terms of trade (TOT) calculated by the ratio of export value over import value, and ε_t is the error term. Parameter k represents the inflation threshold level in the relationship between inflation and economic growth. Finally, DU is a dummy variable, and equals to one when inflation level is higher than k percent and zero vice versa.

The equation (1) could be estimated to identify inflation threshold by using the Ordinary Least Squares (OLS) method, and then Two-Stages Least Squares (2-SLS) and Generalized Method of Moments (GMM) techniques were applied to deal with endogeneity. In addition, the results from 2-SLS and GMM methods were then compared with estimated result from OLS. Threshold levels used for calculation range from \tilde{k} to \bar{k} . Continuously, the optimal threshold k^* will be chosen to capture the smallest sum of squared residuals (RSS) value or the inflation threshold is the level that maximizes R square. The minimization of RSS is found via using the following formula:

$$k^* = \arg \min_k \{S_1(k), k = \tilde{k}, \dots, \bar{k}\} \quad (3)$$

Where, $S_1(k)$ is the sum of squared residuals from estimating equation (1). At the defined inflation threshold of k^* , the relationship between inflation and economic growth is interpreted as follows: (i) β_1 at the inflation rates equal to or lower than the threshold level and ; (ii) Sum of β_1 and β_2 at the inflation rates higher than the threshold level. Naturally, the β_1 value is significantly positive but the sum of β_1 and β_2 value is negative.

4.2 Data Description

This study applied annual time series data to estimate the threshold effect of inflation on economic growth in Vietnam. Our dataset covered the period from 1986 to 2013. Data for most variables (except the investment variable) is retrieved from World Bank (World Development Indicator-WDI) database, and data for ratio of gross domestic investment to GDP (INV) from GSO database. The descriptive statistics of the variables are presented in Table 1.

Table 1. The variables, sources, and descriptive statistics

Variable	Description and source	Mean	Std. Dev.	Min	Max
Δ GDP	Growth of real GDP	6.51	1.61	2.80	9.50
INF	Inflation rat	57.5	118.9	2.70	411.1
INV	Ratio of gross domestic investment to GDP	26.7	7.81	12.5	39.5
OPENNESS	Trade openness	1.01	0.42	0.19	1.65
POP	Growth rate of population	1.51	0.46	1.04	2.50
TOT	Terms of Trade	0.82	0.18	0.26	1.10

Source: Calculation using data from WDI and GSO

5. Research Results and Discussions

In order to define the threshold at which the relationship between inflation and economic growth in Vietnam turn from positive to negative, equation (1) will be applied. In this equation, the inflation thresholds ranging from $\tilde{k}=1$ to $\bar{k}=20$ are applied for testing. After comparing the results, inflation threshold that is determined to be the optimal threshold k^* needs to satisfy three following conditions: (i) This threshold level result in the smallest sum of squared residuals (or the greatest R square), (ii) there is a change in sign of the relationship between inflation and economic growth at the threshold k^* , and (iii) estimated coefficients α_1 và α_2 are statistically significant.

This paper employed three estimation methods (OLS, 2-SLS and GMM) to identify the inflation threshold. The estimated results from equation (1) with k ranging from 1 percent to 20 percent are presented, with each increasing rate of 1 percent. The results from three methods found that the inflation threshold in inflation-economic growth nexus in Vietnam for the research period is about 7 percent. Table 2 showed the estimated results of equation (1) at inflation threshold k^* of 7 percent.

Table 2. Estimation results at $k^* = 7$ percent

Variable	OLS	2-SLS	GMM
INF	0.369** (2.182)	0.372** (2.393)	0.394*** (4.307)
DU*(INF-k)	-0.380** (-2.269)	-0.385** (-2.513)	-0.408*** (-4.557)
INV	0.182** (2.097)	0.134* (1.685)	0.151* (1.721)
POP	1.622 (0.711)	1.219 (0.591)	1.654 (1.085)
OPENNESS	-3.194* (-1.863)	-3.192* (-1.972)	-3.193** (-2.847)
TOT	2.483 (0.500)	0.959 (0.198)	1.486 (0.299)
Constant	-0.843 (-0.091)	2.144 (0.253)	0.578 (0.070)
R square	0.6688	0.6360	0.6294
RSS	26.172	20.295	20.666

Notes: t-statistics are in parentheses;

* significant at 10%; ** significant at 5%; *** significant at 1%.

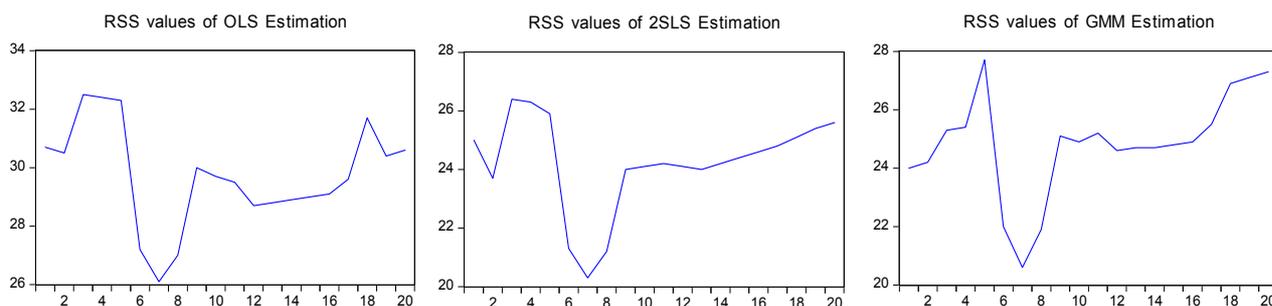


Figure 2. Residual sum of squares as a function of the threshold level

The results indicated that inflation threshold in Vietnam during the research period is 7 percent at significant level of 1 percent using GMM estimation, and 5 percent for OLS and 2-SLS estimation. Thenceforth, the $k^* = 7$ percent is the threshold at which the relationship between inflation and economic growth in Vietnam changes from positive to negative sign. That is, if annual inflation rate does not exceed 7 percent, it will facilitate economic growth more rapidly (positive relationship). However, when inflation increases up to more than 7 percent, it will inhibit economic growth (negative relationship). From GMM estimation results, at inflation rates lower than the identified threshold, it is obvious that there is a positive relationship between inflation and economic growth at 1 percent significant level. In particular, 1 percent increase in inflation will lead to 0.394 percent increase in economic growth. In addition, the sign of regression coefficient showed that 1 percent increase in inflation, at inflation rates higher than the identified threshold, is associated with 0.408 percent decrease in economic growth ($\beta_2 = -0.408$ and statistically significant at 1 percent)

From the research results, the inflation threshold level in Vietnam was found to be different from those in developing countries that were identified in the previous studies. Specifically, inflation rate in Vietnam is lower than those in developing countries that were found to be 11-13 percent in a research by Khan and Senhadji (2001), or 17 percent by Kremer et al. (2013) or 17.5 percent by Villavicencio and Mignon (2011), or 18.9 percent by Seleteng et al. (2013), and much lower than the level of 40 percent found in a study by Bruno and

Easterly (1998). However, inflation threshold in Vietnam is higher than the level of 5.43 percent in a research for the case of Asian countries by Vinayagathan (2013).

The research results also bring about some important policy implications to enhance economic growth in Vietnam. The results also showed that the ratio of total domestic investment over GDP (INV) has positive relationship with economic growth, which indicates that domestic investment contributes to economic growth in Vietnam. However, the estimated coefficient of INV is rather low ($\beta_3 = 0.1$), which mean the effectiveness of domestic investment in Vietnam is not high. According to a report by GSO in 2012, although Vietnam's economy was established and operated under market economic model, state-owned sector still accounts for large proportion but has the smallest efficiency, which is reflected via the highest ICOR. The Government has put a lot of effort in privatizing the State-owned corporations; however, the state-owned sector still accounts for 38.7 percent of total investment capital. Therefore, the analysis results supported that the Vietnamese Government need to reduce the amount of state-owned enterprises and concentrate on capital efficiency instead of increasing the amount of capital only.

In addition, the trade openness ($\beta_4 = -3.1$) has positive relationship with economic growth, and this result is consistent with actual data when trade balances in Vietnam constantly suffered from a prolonged deficit from 1986 to 2011, and the trade balance in Vietnam gained explicit only in 2012 and 2013 for research period. The results suggested that the Vietnam's Government should implement strong solutions for export promotion and import restriction to associate international trade expansion with economic growth in Vietnam. Finally, the estimation results also show that POP and TOT have no impact on economic growth in Vietnam during the research period.

6. Conclusions and Policy Implications

Many countries currently apply a monetary policy with a specific target inflation rate as a basis for inflation adjustment in the economy. However, only when the threshold inflation is defined can these countries propose target inflation rate precisely. This paper provided a new empirical finding on the non-linear impact of inflation on economic growth in long term for the case of an Asian developing country. This study employed the annual data in the period of 1986-2013 in Vietnam to estimate the inflation threshold at which the inflation-growth nexus turns from positive (i.e. inflation stimulates growth) to negative (i.e. inflation inhibits growth).

This paper investigated the inflation threshold of a country in transition process from a communist centrally-planned to a market economy. Thenceforth, the research results contributed to theoretical framework of inflation threshold in developing countries in the world. This study applied three methods of OLS, 2-SLS and GMM to prove the existence of non-linear relationship between inflation and economic growth in Vietnam. The results indicated that there exists an inflation threshold level at 7 percent in Vietnam. The policy-makers need to define a target inflation as a basis for macroeconomic policies adjustment and maintain real inflation rate close to the expected target. Thenceforth, the above-mentioned inflation threshold may be referred for constructing a target inflation rate. In addition, Vietnam should enhance domestic investment regarding value as well efficiency to promote economic growth. Simultaneously, Vietnam also needs to re-consider the international trade policies to stabilize trade balance for the long-term economic growth.

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