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EXAMINING THE INFLATION-OUTPUT GROWTH IN MALAYSIA

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This paper extends the analysis on the inflation-growth relationship to the case of Malaysia. The main objective of this analysis is to reveal is there symmetric or asymmetric relationship between the two variables and how such relationship varies over time. In addition, we also seek to determine the main factors contribute to economic growth in Malaysia. For the purpose of analysis, the threshold breakpoint regression and the robust regression (M-estimator and MM-estimator) are applied on the annual data ranging from 1966 to 2015. Our results fail to detect inverted-U curve and trade-off relationship between inflation and growth except for the period of 1980's to 2015. The results imply to dynamic relationship of inflation-growth which may vary over time. Expected inflation can have significant positive impact on growth. Our study suggests a crucial role for the policymaker to maintain price stability for sustainable growth.

Keywords: Inflation-growth trade-off, Nonlinear model, Phillips curve, Robust estimator.

Introduction

The study on the relationship between inflation and economic growth (or unemployment) is crucial as it provides understanding on how inflation can affect economic growth and the transmission of inflationary effect to the economy. The understanding of the relationship also provides important information on the formation of monetary policy and guideline for a policy decision. According to the theory explained in Phillips curve, inflation and economic growth (unemployment) has a negative relationship where lower inflation is linked to lower growth (or higher unemployment). This leads to the dilemma in the policy decision/ targeting where lower inflation and high growth cannot be achieved together. That is, lower inflation is achieved with a trade-off or sacrifice cost of lower growth. The Phillips curve was able to explain the trade-off relationship on the macro data in the 1950's and 1960's but failed to explain the stagflation (high inflation and high unemployment) in the 1970's and 1980's. Therefore, the theory of Phillips curve had received many debates and critics. Among them, [1] and [2] claimed that the trade-off between inflation and unemployment only exist in the short-run but no more in the long-run. They

supported the concept of natural rate of unemployment which saying that inflation will stable when the labor market reached the equilibrium, the natural rate of unemployment.

Despite the theoretical debates, empirical studies have moved on examining the existence of a nonlinear or asymmetric relationship between inflation and growth. Considering the previous debates and theories, this paper continues the examination of the inflation-growth relationship in Malaysia through inverted-U curve using robust estimation and breakpoint regression. In particular, we seek to reveal if the nonlinearity relationship follows the inverted-curve and if such relationship changed due to breakpoint effect. In addition, we also seek to investigate if the expectation of inflation matters, i.e. if the lead of inflation has an expectation effect on growth and how large the impact of inflation on growth relative to other factors. Our results show no inverted-U curve and no trade-off in the relationship of inflation-growth in most cases. The only exception is under breakpoint regression between 1980's to 2015. Besides, expected inflation has a positive impact on growth and it overtakes the impact of inflation on growth. Our results suggest that the relationship between inflation and growth is dynamic which may change over time. Although inflation does not bring large trade-off cost to Malaysia, it is crucial for the policymaker to maintain price stability for healthier economic growth.

Literature Review

Theoretical Background

The very early theory that explained the relationship between inflation and unemployment is the Phillips curve which represents the inverse relationship between the two variables. Originally, Phillips curve was used to study the wage inflation and unemployment in the UK between 1861-1957. This inverse relationship fitted the data well in 1950's and 1960's but not 1970's due to stagflation (high unemployment and high inflation). Phillips curve received many critics. Among them, monetarists argued that such inverse relationship is a short-run phenomenon but is not applicable in the long-run as aggregate supply (AS) curve is inelastic in the long-run (see Figure 1). The increase in aggregate demand (AD) may cause to higher inflation but real wages and unemployment no change. The increases in real wages and unemployment only happen in the short-run. Monetarists claim that the growth of money has an effect on prices but no real effect on growth in the long-run.

Despite the critic from Monetarist, the theories of growth models have different explanations for growth. These theories provide consensus on the inflation-growth relationship. The classical growth theory emphasizes on saving and investment for economic growth and has not specified about inflation. However, this theory implicitly suggested inflation-growth in a negative relationship as higher wage costs lead to lower firm profits ([3]). The Keynesian theory explains growth through AD and AS curves on yielding an adjustment path exhibiting an initial positive relationship on inflation-growth. This theory leads to a short-run trade-off between output and the change in inflation but such trade-off disappear in the long-run. On the other hand, the Neo-classical theory such as Slow-Swan model proposed technology change as the main factor in explaining long-term growth but Mundell model related inflation and inflation expectation to wealth in a negative relation. As discussed in [3], the neo-classical theory can lead to different results on inflation-growth. For instance, the Tobin effect model showed that higher inflation resulted in higher output but higher inflation has no effect on output under Sidrauski and lower output in Stockman effect models. Besides this, the endogenous model shows that inflation has a negative effect on two forms of capital (capital income and human capital) which may lead to a lower rate of returns on both capitals and then lower economic growth.

The failure of Phillips curve to explain the behavior on inflation-unemployment during the stagflation in the 1970's and 1980's led to the debates on the trade-off relationship in Phillips curve. Economists provide two explanations for the shift in Phillips curve. First, as explained by Keynesians, the stagflation (high inflation and high unemployment) was due to the adverse supply shocks in oil prices and petroleum products brought to U.S. during two periods (1973-74 and 1979-80). Such supply shocks

caused to higher production cost which led to the increase in transportation costs of all commodities. This later led to higher price and lower demand and output. Finally, this led to higher price and unemployment. The second explanation as according to Friedman is the trade-off in Phillips curve only holds for short run but not in the long-run. According to Friedman, an economy is stable in the long-run when it is at the natural unemployment rate. When this natural rate is reached, the long-run Phillips curve is vertical and no more downward-sloping as in the short-run ([4]).

Empirical Findings

Despite the long debates on the relationship between inflation and unemployment (economic growth), empirical studies also found no consensus hence disagreement on the relationship and behavior of the two variables. Taking into considerations in the debates on the short-run and long-run Phillips curve, [5] came out with two propositions: (1) no long-run trade-off between inflation and unemployment (growth); (2) there exist a short-run trade-off between inflation and unemployment (growth). According to [8], a majority of the economists and central bankers accept the first proposition. Many of them also believe that inflation can be stabilized through the real impacts from the design of policies. Proposition (2) can be tested in terms of variability trade-off rather than levels over time. Simulations on economic models found such trade-off but there is disagreement among economists on the best model in capturing such relationship. Below is the summary of the previous findings.

The earlier studies on the relationship between inflation and unemployment (growth) conducted hypothesis on Phillips curve. Among them, [7] found trade-off relationship between inflation and unemployment. On the other hand, [8] found no relationship between inflation and growth. Since then, more studies were conducted on modeling the relationship between inflation and unemployment using different models and methods. Among them, [9] applied structural VAR analysis found evidence of the existence of trade-off relationship for the data of U.S. Applying the cointegration regression, [10] detected the trade-off relationship for U.S. and Japan in the samples of industrialized economies. More recently, many studies found evidence on the flattening of the Phillips trade-off. The two main reasons for this phenomenon include (1) inflation expectation appears to be a better anchoring on characterizes the current period data and (2) the globalization effect ([11]).

Rather than modeling inflation-unemployment and conducting the Phillips hypothesis, a number of studies have shifted to modelling the inflation-growth relationship and the impact of inflation on growth. Among the earlier study include [12] who revealed a negative impact of inflation on growth. Other studies also reported same results ([13] and [14]). Cross-country studies showed an inverse relationship between inflation and growth and the magnitude of the relationship may vary across regions and countries depending on the level of development and other factors ([15]).

More recently, there are suggestions that the relationship of inflation-growth is not simple, but different level/ rate of inflation can affect economic growth differently. Such relationship may subject to extensive theory and empirical approach, for instance, linear versus nonlinear regression. In order to capture the asymmetric and threshold effect of inflation on growth, many studies have adopted the nonlinear techniques. These studies include [16] using OLS with a structural break, [17] using conditional least square, [18] using threshold autoregressive models, [19] using panel data approaches, [20] with smooth transition regression model and [21] applied quadratic and threshold endogenous models. Many studies detected nonlinear or threshold effect of inflation on growth. Such nonlinearities have prompted a question at what level inflation is harmful to an economy. For instance, [19] used the panel dataset consisted of 140 industrials and developing countries ranging between 1960 and 1998. The study applied the conditional least square method. The results showed that the estimated threshold for inflation is 1-3% and 11-12% for industrial and developing countries respectively. Inflation has no effect on growth below the threshold but above the threshold, inflation has n negative effect on growth. On the other hand, [21] focused the study in Tanzania between 1967 and 2015 using quadratic and threshold endogenous models. The study detected a U-shaped relationship between inflation and growth. The optimal inflation rate was estimated to be in the range between 3.25% and 3.75%.

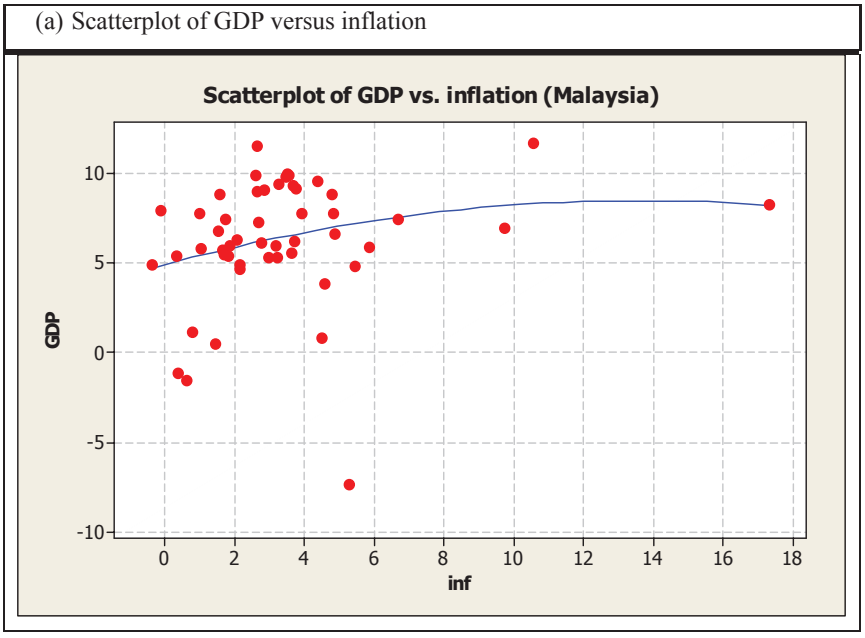
In addition, some studies model the relationship between inflation and growth in an inverted-U curve and calculated the turning point in which inflation rate is at the optimal level associated with highest economic growth. After this point, inflation is harmful to growth. Among these studies include [19], [22] and [23]. For instance, [22] focused the study in Kenya, Tanzania and Uganda on the panel data set between 1970 and 2013. Applying the nonlinear quadratic model (inverted-U curve), they found that the turning point or optimal inflation rate to be 6.77%, 8.80% and 8.41% for Kenya, Tanzania and Uganda respectively.

To be summarized, the main focus research in the relationship between inflation and growth is on the trade-off relationship. Although recent studies have switched the analyses to the dynamic relationship (nonlinearities and threshold effect), the main concern is still on how influential inflation on growth and if inflation is harmful to growth. Such nonlinearities approache provide deeper information on the dynamic relationship between inflation and growth and could be useful for policy design and decision. However, there is still no consensus on the relationship between inflation and growth as results may vary across countries impacted by some factors such as estimation approaches/ method, economic structure, disturbances, policy design and time frame.

In Malaysia, inflation has been relatively low compared to the international standards. The inflation rate stayed low even after the financial crisis of 1997. Figure 1 shows the scatterplot and line plot between inflation and GDP growth. The scatterplot shows the possibility of a quadratic relationship between the two variables while the line plot exhibits the historical movements of these two variables between 1966 and 2015.

From the line plots (Figure 1), it is observed that the inflation rate in Malaysia was as low as a single-digit at around 2% in mid-1960 prior to the world oil price crisis in 1973-74 of Yom Kippur War. Such crisis caused to a sharp rise in inflation to 10.56% in end 1973 and 17.32% in 1974. Such high inflation was followed by a recession in 1975 due to the world economic stagflation. GDP growth experienced drastic drop from 8.31% in 1974 to only 0.80% in 1975 while inflation declined from 17.33% to 4.49% for the same period. Malaysia experienced a second recession in 1981 due to the global economy recession in early 1980's. Such recession caused by inflation to reach 9.70% while GDP was not much affected at 6.94% in 1981. However, GDP experienced a sharp drop from 7.76% to -1.12% between

(a) Scatterplot of GDP versus inflation



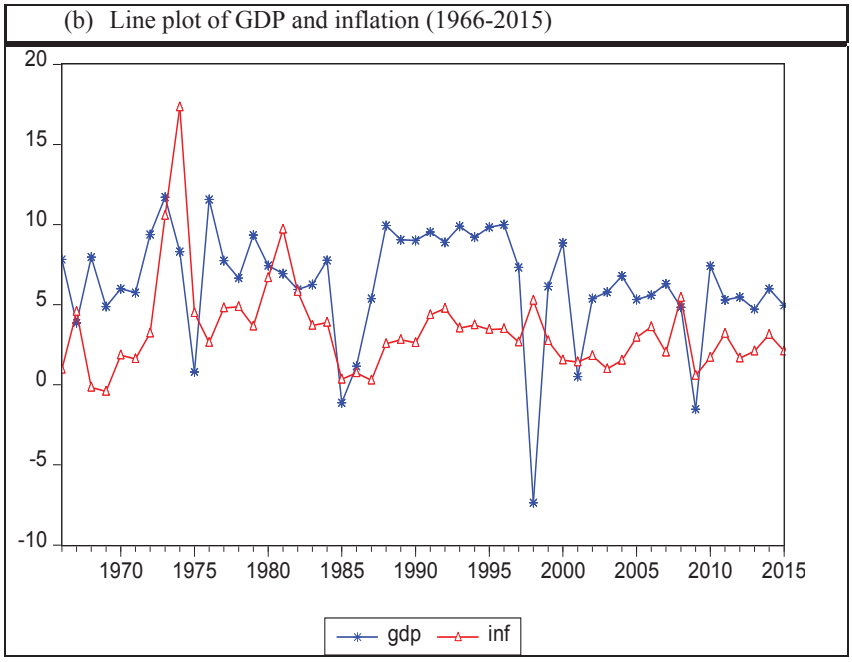


Figure 1. The plots between GDP and inflation

the year 1984 and 1985 due to the recession of economy in 1985. Inflation reached 0.35% in 1985. The economy recovered and experienced stable high growth at average 8.92% and average inflation 3.12% between 1987 and 1997. Such high growth collapsed in 1998 to -7.36% while inflation rate stayed at 5.27% due to Asian financial crisis (1997-98). The economy recovered and regained stable growth around 5.55% while average inflation 2.41% between 1999 and 2008. Again, Malaysia experienced another episode of the recession in 2009 with GDP growth -1.51% and inflation 0.58% caused by the global great recession and U.S. subprime mortgage crisis in late 2000's. The economy of Malaysia remains stable in 2010's with the growth rate around 5% and inflation around 2%. Based on the historical data, we observe that the economy of Malaysia is greatly affected by external factors/ shocks such as oil price shocks and global recessions besides its internal factors.

Data and Methodology

This study focuses the analysis in Malaysia for the period of 1966-2015. The annually data are collected from the World Bank (World Development Indicators) which include GDP growth rate (%, GDP) and inflation rate (%, INF). Economic growth is represented by GDP which is also the dependent variable in our study. The inflation rate is the explanatory factor.

According to (24), inflation was not a robust explanatory factor on growth as the significance of inflation get declined when other conditioning variables are included. According to (25), the relationship may not robust once conditioning variables are included in the regression. Besides, conditioning variables could be functions of inflation. Including these variables in the regression may reduce the effect of inflation and underestimate the impact of inflation on growth. Based on these discussions, our inflation-growth regression only include the inflation variable alone which consists of inflation current rate, inflation quadratic and inflation expectation:

$$GDP_t = f\left(INF_t, INF_t^2, INF_{t+1}\right)$$

This relationship can be modelled in the inverted-U curve equation as below:

$$GDP_t = c + a_1 INF_t + a_2 INF_t^2 + a_3 INF_{t+1} + \varepsilon_t$$

where c is the constant term, while with i =1,2,… denotes the coefficients of explanatory variables. a_1 captures the linear relationship while a_2 captures the quadratic relationship and a_3 captures the effect of inflation expectation on growth. This equation is estimated using the ordinary least squares (OLS) method. However, considering that OLS is not robust to outliers and structural breaks, robust estimation (M-estimation and MM-estimation) and breakpoint regression are implemented as well. The analyses take the following procedures: first, all variables are tested with unit-root tests for stationarity checking; this step is followed by estimation (OLS, robust estimations and breakpoint regressions).

Results and Discussion

Prior to the estimations, unit-root tests of Augmented Dickey-Fuller (ADF), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and Zivot-Andrews are performed for the checking of stationarity. Zivot-Andrews test takes into consideration the structural breaks in the series while ADF and KPSS do not consider for structural breaks. The results are summarized in Table 1.

The null hypothesis under ADF and Zivot-Andrews tests is the series has unit-root (not stationary) while the null hypothesis for KPSS test is the series is stationary. Therefore, rejection on the null hypothesis leads to the conclusion of stationary for ADF and Zivot-Andrews tests but non-stationary for KPSS test. As observed in Table 1, all variables are significant under ADF and Zivot-Andrews tests. This leads to the rejection of null hypothesis so that the conclusion is all variables are stationary at levels. On the other hand, KPSS test shows that all variables are not significant at 5%, which lead to the same conclusion, i.e. all variables are stationary at levels. Since all variables are significance at levels or I(0), we proceed with the estimation using variables denoted in levels.

Table 1. Results – Unit-root tests

Variable	ADF	KPSS	Zivot-Andrews
GDP	-5.9713***	0.2586	-7.1922***
INF	-4.1281***	0.2469	-5.4180***

Note: *** indicates significance at 1% level

The results of estimations are summarized in Table 2. As mentioned earlier, OLS estimator is not robust for data containing outlier/ extreme values and structural breaks. Referring to the plots on GDP and inflation (see Figure 1), we observe some extreme values (panel (a)) in the scatterplot and structural breaks in line plot (panel (b)) during mid-1970's and mid-1990's due to recession and Asian financial crisis 1997. Also, the influence statistics and leverage plots also detect some outliers (see Figure 2 and Figure 3). Influence statistics show some sharps breaks outside the two confidence intervals while leverage plots show some outliers lying far away from the horizontal red line at zero. Due to these extreme values and structural breaks, robust estimations and breakpoint regressions are applied. Robust estimations consider for outliers while breakpoint regression takes into consideration for structural breaks.

Observing Table 2 for baseline GDP equation, the results show that inflation expectation has significant effect on GDP under different estimation approaches. The increase of expected inflation rate leads to higher GDP growth. The results show that expectation on inflation plays an important role on

influencing the behaviour of economic agents (producer and consumer), which will affect the aggregate demand and aggregate supply and then finally economic growth. Expected inflation does not lead to trade-off in terms of lower GDP growth. This expected inflation over take the impact of current inflation INF_t and nonlinear inflation INF_t^2 on growth. Both INF_t and INF_t^2 have no significant effect on GDP growth in all cases except for the period 1984-2015 under breakpoint regression. Current inflation has a positive impact on growth but INF_t^2 has a negative impact on growth. The results imply a nonlinear inverted-U curve relationship between inflation and growth during 1984-2015 and the turning point is $-\frac{a_1}{2a_2} = 2.98$.

Summing up all results, we conclude that inflation and growth has a dynamic relationship which may vary over time due to breakpoint effect/ external shocks. Expected inflation is influential in affecting the behaviour of publics and GDP growth. Therefore, effective monetary policy is crucial in order to maintain price stability for stable and sustainable growth.

Table 2. Results – Baseline GDP equation

Variable	OLS	Robust		Threshold Breakpoint	
		M-estimator	MM-estimator	1966-1983	1984-2015
C	4.5214***	5.6941***	5.0822***	6.2499***	-2.1441
INF	0.0383	0.0676	0.2208	-0.6226	6.0125***
INF*INF	-0.0017	-0.0025	-0.0105	0.0349	-1.0078***
INF(+1)	0.4974**	0.3438**	0.3650**	0.4968**	0.4038
R-sq	0.18	0.14	0.17	0.45	0.45

Note: ** and *** denote the significance at 5% and 1% respectively

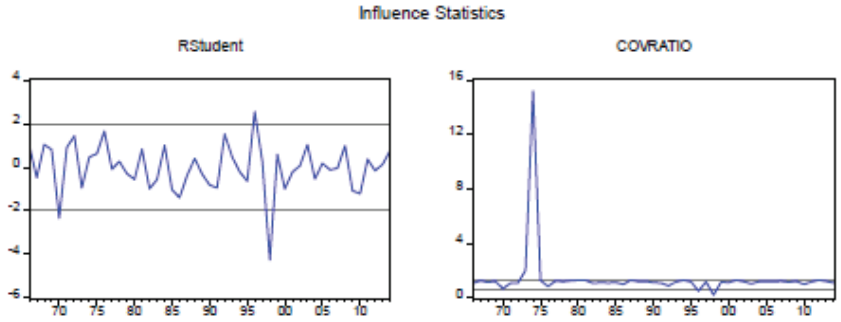


Figure 2. Influlence statistics

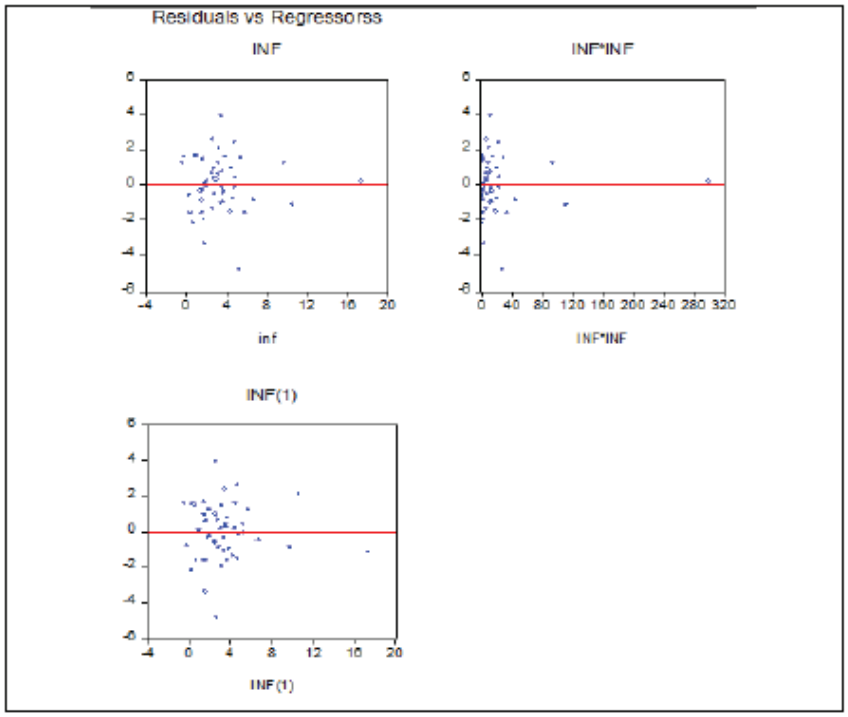


Figure 3. Leverage plots

Conclusion

We conduct empirical analyses using different approaches on investigating the relationship between inflation and growth. The study is focused in Malaysia for the period of 1966-2015. We apply the inverted-U curve on modeling the relationship between inflation and growth. The results from OLS, robust estimations and breakpoint regression fail to detect trade-off relationship except during mid-1980's to 2015. The results imply that the relationship between inflatina and growth is not a simply linear one but it may change over time. Besides, inflatin expectation overtakes the impact of inflation on growth but it does not lead to trade-off in terms of lower growth. Our results demonstrate that expected inflation can affect the behavior of publics and GDP growth. Due to breakpoint effect/ external shocks, the inverted-U curve relationship is detected for the period 1984-2015. Therefore, it is important for the policymaker to maintain price stability in order to avoid trad-off cost and to sustain economic growth.

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